VOLUME 60 JULY, 1948 NUMBER 1

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The AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

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American Roentgen Ray Society · *Forty-ninth Annual Meeting*
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THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. 60 JULY, 1948 NO. 1

MICRO-ARTERIOGRAPHY*†

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IN THE course of experimental work on rabbits, designed to investigate the causation of traumatic uraemia (1946), (1947), our results indicated the need for a close study of the intrarenal vascular system. These results had strongly suggested that, under certain conditions, blood circulating through the kidney was taking a route other than that generally attributed to it; more specifically, that it was taking a short cut from the arterial to the venous side, leaving the cortex either partially or completely ischaemic. The observations, which were obtained by the use of various experimental techniques (arteriography, including direct cineradiography; direct observations of colour changes in the surface of the kidney and in the blood of the renal vein; injections of dyes) seemed to admit of no other explanation. The application of ordinary radiographic techniques to kidneys injected with contrast media, while demonstrating the vascular system as a whole and the altered distribution of the intrarenal blood in special circumstances, failed to show any direct arterio-venous communications of a size visible to the naked eye, and, because of inadequate definition, provided no information as to the smaller vessels in the region in which anastomoses were suspected. It was this limitation of the ordinary techniques that stimulated us to attempt the development of a method for demonstrating radiographically the more minute vascular structures.

The need for finer detail in radiographs [to show the calciniferous glands in worms; Robertson (1936)] had been adequately met by the use of lantern slides instead of X-ray film. Apart from this we had no experience, nor did we know at that time of any papers on the subject except that of Lamarque (1938), who had succeeded in showing the microscopic detail of histological specimens in amazing detail. This intricate technique, however, was unsuited to our needs, for it was not only too complex but was designed to give detail of tissue structure that would merely obscure the picture we desired, *i.e.*, a radiograph that showed the opaque material in the vascular system uncomplicated by other shadows. We, therefore, pursued our investigations with such means as we had at our disposal, achieving in a few

* A preliminary note of the technique was published in 1946; Barclay, A. E., Daniel, P., Powell, H. M., and Prichard, M. M. L. "Radio-micrography," *Journ. Physiol.*, cv, 28–29.

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weeks, on an experimental basis, the type of result we aimed at. Owing to war conditions we were quite unaware that several continental workers had already explored the ground and obtained similar results. Bohatyrtschuk (1944) gives a full history and bibliography of the progress that has been made on the subject. He also carried out a considerable number of experiments

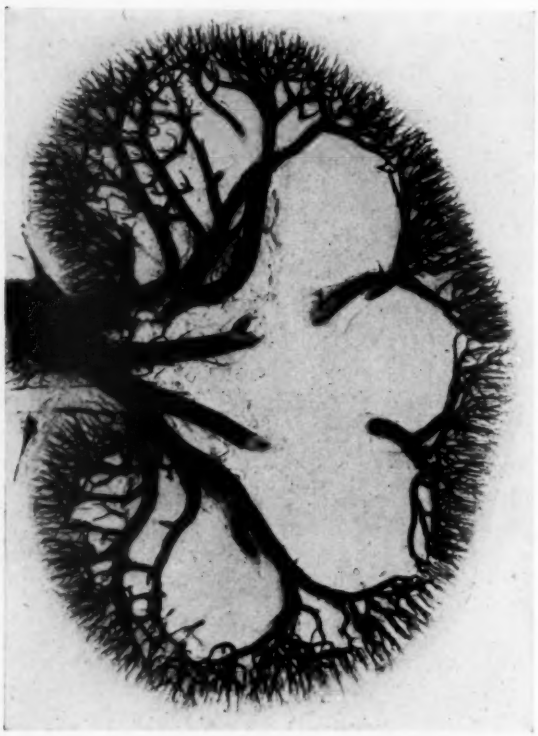

Fig. 1. Radiograph of a slice of injected rabbit's kidney enlarged ×3.

with micro-arteriography, noting the effect of drugs and of heat and cold. The technical conclusions at which we arrived are very similar to those obtained by these other workers, whose main interest lay in the development of the technique. They explored in detail the physical and chemical factors involved. We, on the other hand, merely experimented with such facilities as lay at hand and found that with relatively simple means we could fulfill our more limited requirements. We were fortunate, however, in that a photographic film that met our needs had become commercially available, while these workers had to make their own emulsions for the purpose. By comparison, our problem was simple for, whereas they aimed at the differentiation of cellular elements differing little in atomic weight and therefore in ratio-opacity, we aimed only at differentiation between normal tissue and radiopaque material, *i.e.*, between elements that are near the lower and upper limits of the atomic series. For our purposes there was no need to use the very soft radiations, bordering on Grenz Rays, essential in the differentiation of tissues.

We had already radiographed many injected kidneys, and slices of such kidneys, on photographic materials normally available (Fig. 1), but, as already stated, the closest study of these stereoscopic pictures failed to show any indication of the anastomoses we suspected. These must, therefore, lie in vessels too small to be seen unless considerably magnified. Owing to the grain of the X-ray film, our radiographs could not be enlarged by more than a few diameters, and we decided to explore the possibilities of using photographic material of much smaller grain size in order that the radiographs could stand enlargement. We also decided to explore the radiographic effect of utilising much softer types of rays than could pass through the glass wall of an ordinary X-ray tube.

Photographic emulsions

For our investigation, four types of photographic emulsion were used:

(1) Ilfex: a radiographic film used without intensifying screens. On this film (or on Crystallex, a similar type of film but of rather finer emulsion), most of our exsected specimens had been radiographed.

(2) Process: a type of emulsion employed for lantern slides and contact film reproduction. The grain size of this emulsion is very much less than that of Ilfex.

(3) Kodaline: a film that was much used during the war for photographic recording in miniature of documents, plans, etc. The grain size of this emulsion allows very considerable enlargement.

(4) Maximum Resolution: a new type of film* that is capable of carrying an image that may be greatly enlarged. It is reputed to be capable of resolution to 1,000 lines.†

The sensitivity of photographic emulsions is closely linked with the grain size; the finer the grain, the greater the exposure that will be necessary. If, in round figures, Ilfex requires a factor of 1, Process will need 20, Kodaline 200, and Maximum Resolution 2,000 times the exposure, *i.e.*, an exposure of 1 second on Ilfex would need about 30 minutes at the same settings to obtain equivalent exposure on Maximum Resolution film.

For the detailed study of even the larger vessels of an organ so small as a rabbit's kidney, the radiographic image must be very considerably enlarged. To see capillaries with the unaided eye, these have to be enlarged by about 35 diameters. But enlargement by only two or three diameters made the grain of the Ilfex film so obvious that it obscured all detail. Still using the ordinary X-ray tube, we then tried Process film. This showed a marked increase in detail, and Kodaline gave still further improvement. Nevertheless, the results would not stand much enlargement and, moreover, they were grey and lacking in contrast. Maximum Resolution was also tried, but the exposure factor was so high that it was difficult to obtain even a faint image.

Use of softer rays

Ordinary X-ray apparatus is usually provided with controls that allow the use of radiations down to about 40 kV. The glass wall of ordinary X-ray tubes is said to be equal in density to about 1.7 mm. of aluminium, and therefore filters out most of the softer radiations in the composite beam that come from the target. Such rays, although likely to be of value for thin sections, are of no value in clinical radiography, as they could never reach the film. Hence the beam from an ordinary X-ray tube, even at its lowest setting, would be too deficient in the softer wave lengths to be of much value for our purpose. Experience had shown that even with relatively thick slices of specimens it was difficult so to adjust the exposure as to obtain even a faint shadow on our radiographic materials. The margin of error was small and the actual detail poor, even allowing for the graininess of the film. What was needed seemed to be a bundle of X rays that was very rich in those of long wave lengths, *i.e.*, an X-ray tube that was fitted with a window of low density. Tubes of this type are in routine use for diffraction work in crystallography departments. They are fitted with aluminium foil or other type of window of low atomic weight, such as beryllium or lithium. The early tubes of this type were frequently home-made and connected to a pump by which they were exhausted to the required vacuum. They could be repaired very easily and at small cost, and on the score of economy and also because hot cathode tubes were in short supply such tubes have remained in use.

When we asked for help from the crystallography department, hot cathode diffraction tubes were not available owing to breakdowns and the impossibility of replacing them at the time. It was, therefore, with one of the home-made gas tubes that our first experiments were made. Such tubes are difficult to manage at low voltages as they tend to reverse. Although we obtained excellent results with the gas-filled diffraction tube, we did not learn the art of its management for radiography sufficiently well to be able to control our results. The output of the tube was low and with Maximum Resolution film the ex-

* For convenience we have now replaced films with glass plates as they are more easily handled.

† Since this was written we have been supplied with Kodak 050 type MR plates, emulsion No. 1565. The grain size of this emulsion appears to be smaller than that of Maximum Resolution.

posures ran into several hours. Nevertheless, it is likely that a skilled worker who has learned the art of tube management would be able to attain excellent results in this type of work even with a coil outfit and this cheap and easily repaired tube.

For our first trial in radiographing a section of tissue with the gas-filled diffraction tube we used Process film. The result was startling and showed detail of an order that went far beyond what we had thus far attained. Kodaline film used with this tube gave even greater detail; it seemed, in fact, to come well within measurable distance of recording vessels of the smallest size. With Maximum Resolution film we were able to obtain radiographs that seemed completely to meet our needs, *i.e.*, to show vessels down to those of capillary size.

Our results with the gas tube were so encouraging that we decided to install apparatus designed specially for this class of work. A half-wave transformer happened to be available and this was coupled up to a Machlett shockproof hot cathode diffraction tube. This apparatus gives accurate control at from 5 to 50 kV, and up to 20 mA. The tube has a molybdenum target, is water cooled, and runs continuously and steadily at 20 mA at any required voltage. It is fixed horizontally above a table and has two beryllium windows that are set approximately at 180° to each other. Normally it is used with the windows giving horizontal beams, but, if needed, it rotates to give a vertical beam for radiographing objects on the table, or thick and heavy specimens which would not be easy to fix in the vertical position.

In the design of any apparatus that must record fine detail, the elimination of vibration is essential. To provide a heavy concrete foundation is expensive, and we decided to try and eliminate vibration from outside sources by making the apparatus self-contained. To this end, a casing was made to enclose the tube head. Corresponding to each of the windows of the X-ray tube, this casing was threaded to take brass cones tubes of $2\frac{1}{2}$ in. diameter and of various lengths that screw firmly onto the tube-head housing. The cassettes that carry the film fit snugly and firmly onto the end of these brass tubes. Thus the unit is not only self-contained and unaffected by external vibration, but is also self-contained as regards X rays. Hence, the room in which this apparatus is used also serves as the dark room—a great convenience and time saver in this class of work.

The focal spot of the gas tube we used in our first experiments was of the order of 0.5 mm. Our hot cathode tube has a focal spot of about 1.0 mm. So far as we can determine, this increase in size has no appreciable effect on the sharpness of even relatively thick sections at the distance of 8 in., which we most frequently employ.

Technique

Naturally the radiographic factors vary with the thickness of the specimen. Complete injected rabbit kidneys or brain, for example, give good results when radiographed at the higher voltages. The results obtained when whole organs or thick slices are radiographed are well in advance of anything possible with an ordinary X-ray tube, particularly if Kodaline film is used. Such radiographs taken stereoscopically can be enlarged either in whole or in part and viewed in an ordinary stereoscope, and are of considerable value in giving the general pattern of the vascular system in an organ. But it is from the radiographs of sections of injected organs, to which the radiography of the whole organ is the prelude, that the main value of the technique appears to lie in research work. For this purpose the organ is injected with radio-opaque material, *in vivo* or after exsection, and is fixed in formal saline in the usual way. After radiographing the whole organ, sections are made in the direction indicated that will give the maximum vascular pattern for study. These may be of any thickness. It is not advisable to cut the sections too thin as the radio-opaque ma-

terial tends to fall out. With this technique, a thicker section than is usual in histology is indicated, since it gives a greater length of vessels before they pass out of the section. On the other hand, if a section is too thick, the resulting radiograph may be too full of vessels and therefore too confused even for stereoscopic studies. Sections of 120μ to 450μ seem to be suitable in thickness. Such sections, although thick for histology, may serve a dual purpose, *i.e.*, the radiograph of the section showing only the vascular elements may be studied alongside of the same section stained or injected for histology.*

Mounting the specimen

In order to obtain the maximum of detail recorded on the radiograph, the specimen should, theoretically, be in direct contact with the emulsion, which introduces the complication of floating the specimen into position. For the purpose, we employed 50 per cent glycerine in water in order to reduce the chance of shrinkage from evaporation in transit to the crystallography department and during the long exposures of our early work. We found, however, that Maximum Resolution film was so much reduced in sensitivity when wet, even with water, that it was an entirely unsatisfactory method. Bohatyrtschuk employs 3 per cent. gum arabic, but this had the same effect on the film we employ. Although this intimate contact may be ideal for showing the very finest detail, the question arose as to whether it was essential for the type of work in which we wished to employ the technique, and in which a magnification of 40 diameters was all that was aimed at. There is a definite formula for blurring that takes into consideration (1) the size of the focal spot, (2) the target-film distance, and (3) the object-film distance.† Provided that the target-film distance is considerable and that the focal spot is not unduly large, would it be feasible to mount the specimen on grease paper that would be placed on top of the film? This would be an easy technique, but it would interpose the thickness of the paper and, moreover, the paper might not lie flat; but the simplification of the technique would outweigh and slight disadvantage if this method of mounting could be employed. We therefore persisted with our experiments and found that even the best grease paper is slightly hygroscopic and tended to buckle during a prolonged exposure, thereby causing movement. Cellophane was worse in this respect. The most satisfactory waterproof material we have yet found is the tissue supplied for heat mounting of prints.‡

It is a simple matter to test the blurring effect of mounting the specimen on paper. A small piece of the paper is placed on part of a film which is then sprayed with bismuth carbonate dust from an insufflator. An exposure is then made and the resulting radiograph is either examined under the microscope or photographically enlarged. We found that the degree of blurring caused by the interposition of the paper was so slight that it was imperceptible at the target-film distance of 8 in. that we employed in the test.

For mounting the section on the tissue, it is washed in water and then placed in 50 per cent. glycerine and water to prevent evaporation when low voltages and consequent long exposures are employed. If the exposure is not more than a few minutes, this procedure may be omitted. The section is then transferred to the correct position on the tissue so that it is automatically in

* See, for example, Fig. 31 in "Studies of the renal circulation."

† Franke's formula for blurring: (quoted by Bohatyrtschuk)

$$W = \frac{bd}{F-b}$$

when W = blurring;
b = distance of object from the film;
d = size of the focal spot in mm.;
F = target-film distance.

‡ The tissue mounting we now employ is "Stryafoil" which is an extruded polystrene film and is completely impervious to moisture. It casts virtually no shadow at 20 kV and even at lower voltages is hardly seen. The only difficulties are the electrostatic properties and I suspect that there is a tendency for the tissue to "dance" with the bombardment of the rays if the mounted section is a thin light one. Doubtless some way will be found to overcome this if it does in fact exist.

the centre of the field. The surplus fluid having been removed with blotting paper, the tissue carrying the specimen is placed on the film in the cassette, the front of which holds the tissue flat and in position.

We should have expected that the higher age lies in the shorter exposure and the consequent reduction in movement that might come from absorption of moisture into the mountant tissue and consequent buckling, a feature that is reduced but not abolished by the use of glycerine. At 8 in. and 20 kV

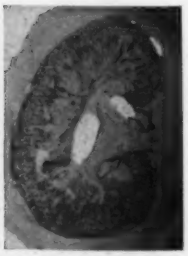

FIG. 2. Contact print of a radiograph of a section (240μ) of a rabbit's kidney, injected with radiopaque material.
Factors: Crystallography diffraction tube, with beryllium window; kV 15, mA 20, distance 8 in.; Maximum Resolution plate (Kodak 050 type MR plate, emulsion No. 1565); exposure 13 minutes.

FIG. 3. Enlargement (×4) from radiograph, Fig. 2.

FIG. 4. Enlargement (×15) from radiograph, Fig. 2.

voltages, say 40 or 50 kV, would have "killed" such fine detail as capillaries filled with thorotrast. We found, however, that for this work there is very considerable latitude, and although the fine detail of injected vessels is best shown at about 15 or 20 kV, the structure of the tissue being "killed," it is still well shown even at 50 kV if the negative is not overexposed. The advantage of using the highest efficient volt- and 20 mA, our exposures for a section of 240μ on Maximum Resolution film are of the order of 5 minutes; at 30 kV the exposures are $1\frac{3}{4}$ minutes.

Injection media

We have used a variety of substances more or less experimentally.

(1) *True solutions:* Practically all of those employed in arteriography—

diodrast (perabrodil), uroselectan, pyelosil, etc.—depend on their iodine content for their opacity. Since they diffuse from the vascular system they are not suitable for micro-arteriography preparations.

(2) *Colloidal preparations:* The particles of colloids are small; those we have employed, although they flow freely through the capillaries, do not pass

Fig. 5. Photo-micrograph (×50) of radiograph. Taken from cortex of kidney, Fig. 2, showing the glomeruli, afferent and efferent vessels, and the subcapsular network of capillaries.

through membranes and are therefore satisfactory from the point of micro-arteriography.

Thorotrast is the best known and most widely used of these colloids. It mixes freely and circulates with the blood; it is non-toxic, does not affect the blood pressure, and is a most satisfactory injection medium both for injections *in vivo*, and for micro-arteriography. It is colourless, and for this reason we have sometimes combined it with Indian ink or some staining material in order to observe the course of the injection.

Colloidal metallic gold (red) 10 per cent.: This is a very satisfactory medium which not only flows freely but has a rich maroon colour that is useful for microscopical study.

Fig. 6. Enlargement (×5) of a group of glomeruli from photomicrograph, Fig. 5, *i.e.*, an enlargement from Fig. 2 of ×250.

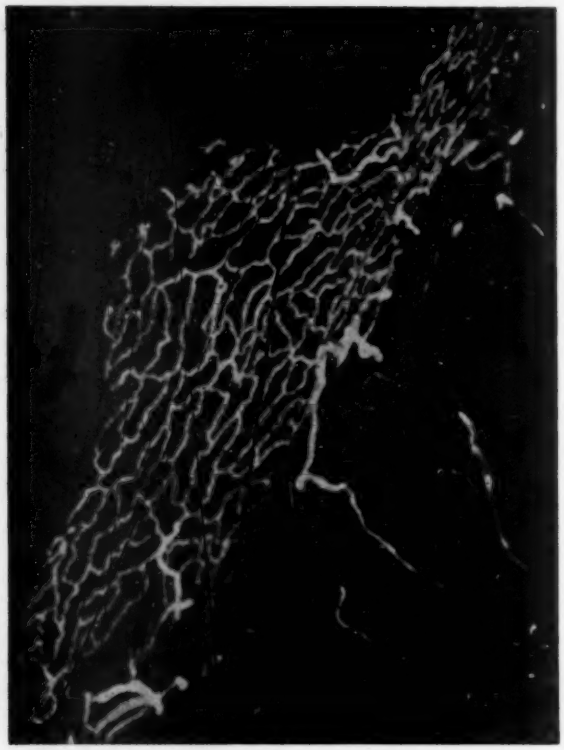

FIG. 7. Photo-micrograph (×50) of radiograph. It shows the capillary network in a fragment of detached membrane in the pelvis of the kidney in Fig. 2.

Colloidal silver iodine (*approximately 10 per cent.*)*:* This also is very satisfactory for filling the finest vessels. It has a light orange colour, is said to be non-toxic, and might be used for *in vivo* injections. It seems to flow even more readily then colloidal gold, but does not appear to "set" well in the vessels and tends to fall out when sections are cut. We are informed that the addition of 3 per cent gelatine would not affect the colloidal state of the injection mass.

Colloidal metallic bismuth: This is an intensely black mass and is also satisfactory from the radiographic point of view, but we found that the samples employed in our earlier work did not flow freely into the capillaries. Seemingly, the preparation we worked with did not remain in colloidal state, as the bismuth settled to the bottom of the bottle. On examining the precipitate under the microscope we found that the particles had agglomerated into masses of considerable size that would clearly not pass through capillaries. On adding "Wettal" (which alters the surface tensions in the fluid) and shaking, the size of the agglomerations was reduced to about 10μ. This, therefore, would be a very suitable injection mass when it was desired to show the arterial side as far as the capillaries. We now also have new preparations of bismuth which retain their colloidal state, and which—like the thorotrast, gold and silver—should pass through the capillaries to the venous side.

(3) *Insoluble metallic salts:* The most suitable that we have tried are bismuth carbonate, red lead, and jeweller's rouge. The particles have a tendency to agglomeration that results in uneven filling even of vessels of considerable size. Of these three insoluble salts, the jeweller's rouge will probably prove to be the best as the particles are small and tendency to agglomeration seems to be least marked.

(4) *Rubber Laxtex* injections may also be used. The X-ray density of the material we employ (571 Neoprine Laxtex. B. B. Chemical Co. Ltd. Leicester, England) gives satisfactory radiographs of larger vessels provided that the kilovoltage employed is kept down to say 20. It may well be that this injection mass will be of considerable use in that the radiograph will guide the study of the actual neoprine preparation.

Other questions than the mere size of particles and their tendency to agglomerate enter into the problem of the suitability of an injection mass for a given purpose, *e.g.*, the density and the molecular weight. So far as we have gone, it has merely been a case of trial and error.

Cassettes

On the front of the cassette a short wide metal tube is fitted. This slips over the brass cones of the X-ray tube and holds the cassette in position. The cassettes are open to the X-ray tube and therefore have to be applied to the cone in the darkroom. In this way the maximum use is made of soft rays. The back of the cassette is lead covered so that, when in position, there is no escape of X rays.

Target distances

The arbitrary standard distances available are governed by the length of the cones. These give $3\frac{1}{2}$ in., 5 in., 8 in. and 13 in. At $3\frac{1}{2}$ in. the cone of rays is small, and at 5 in. it does not cover the diameter of the cone uniformly. These shorter distances will only be used if it should be necessary to employ very soft radiations, which would be much obstructed by the air column. Normally, 8 in. seems to be satisfactory for specimens of up to 500μ thick, but for thicker slices or for complete organs the full 13 in., or even placing the specimen on the table at 19 in., is an advantage, particularly when making stereoscopic radiographs.

Enlargements

Fig. 2 is a contact print from one of the radiographs of a section. To make enlarged prints of these negatives (Figs. 3 and 4) calls for a first-class lens. Standard apparatus is usually only designed to enlarge up to about ×8. We have made enlargements with such apparatus up to ×28, but beyond a certain point (probably not much more than ×8), the resolving power of the lens fails and, apart from increase in the size of the enlargement, there is no increase in detail. If satisfactory enlargements of ×40 could be made in this simple way, the capillaries would be shown and we should obtain a large scale map of every filled vessel in the section.

Fortunately, however, where the ordinary enlarging apparatus fails, the microscope comes to our aid. Just as histological sections can be photographed through a microscope, so also the radiographic negative can be photographed. To our great surprise we found that when we took such a photo-micrograph of a small area of a radiograph, enlarged ×50 (Figs. 5 and 7), there was a greatly increased degree of detail compared with that which could be obtained at much smaller magnification by the enlarging apparatus. The detail was such that we decided to try enlarging these

Fig. 8. Enlargement (×5) of photo-micrograph, Fig. 7, *i.e.*, an enlargement from Fig. 2 of ×250. These vessels measure 3 mm. in diameter; *i.e.*, the actual vessels are 12μ in diameter; in another similar radiograph the vessels are 8μ.

Fig. 9. Enlargement of radiograph of section of cortex of human kidney (×12).

photo-micrographs. The result is shown in Figs. 6 and 8, and it represents a magnification of ×250. It looks as if higher magnifications might still show even more detail, and that the limit of magnification with adequate detail has not yet been reached. Magnifications of this order would show nuclei and elements of the cell structure, comparable to those shown by Lamarque, if the radiograph had been made for this purpose, *i.e.* if the softest rays had been employed. Whether or not the 5 kV available with our apparatus will be low enough for the purpose we do not yet know, as this is beyond the range, we aimed at.

Fig. 10. Enlargement ×240. Taken from cortex of human kidney (Fig. 9) showing glomeruli and some of the surrounding capillary network.

The great advantage of the enlarging apparatus for magnification is that it gives a picture of the whole section or organ with one exposure on a large sheet of printing paper, but the limit of efficient enlargement by this method does not extend far beyond ×10, and even at this magnification the detail seems to fall off. The microscopic method, on the other hand, gives wonderful detail at high enlargements, but is limited to a small area at a time. Such enlargements could, of course, be pieced together

to give a vast picture showing the whole section of the organ.

The application of the technique is simple and rapid. It requires little skill beyond that of ordinary photographic competence, and can be carried out by an intelligent assistant when once the factors have been worked out.

This technique can be employed analytically. Radiographs of the whole organ, suitably injected, can be taken stereoscopically. From the study of these the general run of the main vessels through the organ can be determined and a slice can then be cut in such a way that it includes these. This slice again can be radiographed stereoscopically to determine the plane in which sections will best show the pattern of the detailed distribution. Serial sections of about 240μ are then made in this plane and are radiographed and then enlarged in the usual way, or, for greater detail, enlarged by photo-micrography. Thus the picture of the vascular supply of the organ can be built up as a whole.

SUMMARY

A technique is described for the radiography of sections of organs injected with radio-opaque material. Success depends on two factors, *i.e.*, a photographic film that is virtually grainless, and the use of radiations of long wave length. These radiographs are highly selective, showing virtually nothing except the radio-opaque material in the vessels. They can be magnified by simple enlargement onto ordinary photographic paper by about 10 to 15 diameters, giving the vascular pattern as a whole and thus forming a link between the macroscopic and the microscopic methods of study. Capillaries, however, are not seen at a magnification of ×15, but if photo-micrographs are taken of the radiograph, a magnification of ×50 gives the detail of capillaries and of every injected vessel. There is so much detail in these photo-micrographs that they can be magnified ×5 in the enlarging apparatus direct onto photographic paper of adequate size, giving a total enlargement of ×250.

ACKNOWLEDGMENTS

Without the helpful collaboration of Mr. H. M. Powell, of the Department of Crystallography, this work would not have been possible. His limited resources in the post-war shortages were freely placed at our disposal. Often at considerable inconvenience, he made many of the early X-ray exposures for us. Moreover, his advice was decisive in the assembly of the *ad hoc* apparatus which Mr. Minns, of Messrs. Watson & Sons, designed for this work. I owe much to my colleagues in our "studies of the renal circulation"—Dr. Trueta, Dr. Franklin, Dr. Daniel and Miss Prichard—whose encouragement has stimulated further effort. In particular I acknowledge the debt to Miss Prichard, who abstracted the literature and did all the stereoscopic radiography of the exsected organs, to Dr. Daniel, who provided the injected sections for the investigation of this technique, and to Miss J. C. Mott, who assisted me with the exposures. For helpful advice and for the preparation of various radio-opaque colloidal substances for our renal studies, and incidentally for this work, I should like to thank Mr. R. T. M. Haines, of The Crookes Laboratories. Mr. M. S. Tuckey, of our own department, has been responsible for all the photographic enlargements, some of which have been on a very large scale; and for the photo-micrographs I am indebted to the Department of Human Anatomy. In the initiation of any new technique it is always difficult to formulate a scheme of notes and records, and I am grateful to Miss R. Kay-Shuttleworth for her help in this matter.

The cost of the apparatus for this work has been met by a generous grant from the Nuffield Foundation, who have shown throughout keen interest in the various researches that have been undertaken in this Institute.

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Vol. 60, No. 1

THE ROENTGEN DIAGNOSIS OF DIFFUSE LEUKEMIC INFILTRATION OF THE KIDNEYS IN CHILDREN*

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IT IS well known that leukemic infiltration of the kidneys is quite frequent, and in a series of 123 fatal cases of leukemia reported by Kirshbaum and Preuss[7], 63 per cent showed definite leukemic infiltration of this organ. Very often the infiltration is in the form of nodules, but with considerable frequency it is diffuse and it is this type of infiltration which will be discussed in this paper, as it is probable that small leukemic nodular infiltration of the kidneys cannot be recognized by roentgen examination.

Ramsay[11] reported 100 cases of leukemia in children under eight years of age, in 3 of which it was stated the kidneys were large and easily palpated; in several instances postmortem examination showed a considerable degree of enlargement. Merrill and Jackson[9] cited 11 instances of leukemic involvement of the kidneys in one of which the infiltration was diffuse; another showed heavy subcapsular, periglomerular, and perivascular tumor cell infiltration involving a large part of the cortex but almost absent in the medulla. In the others, the infiltration was evidently of the focal variety. Barney[2] noted kidney involvement in 18 of 23 cases of lymphoblastoma of the urinary tract coming to autopsy. Baldridge and Awe[1] found microscopic evidence of kidney involvement in 20 of 39 cases with lymphoma, the highest incidence occurring in the lymphocytic type with attendant leukemia. Freifeld[6] reported a case of lymphoblastoma of the kidney in a seventeen year old male, each kidney being enormously enlarged, the right weighing 2,320 grams and the left 2,450 grams with a microscopic picture of diffuse lymphocytic infiltration. White and Burns[12] discussed an instance of marked enlargement of the kidneys in a three week old infant which on pathological examination displayed lymphocytic infiltration of the diffuse type. They also quote Foged[5] who, in writing of leukemic tumors of the kidney, reported a case of bilateral tumor of the kidney in a two year old child with a normal blood picture without splenomegaly or lymphadenopathy. The right kidney was removed and on microscopic examination showed marked, diffuse, leukemic infiltration; later, a typical lymphatic leukemic clinical picture developed. Bell, Heublein and Hammer[3] reported the case of a twenty-two year old male with chronic myelocytic leukemia with enlargement of each kidney which decreased in size at the same time as the blood picture reverted toward normal, following radiation therapy. According to Ewing[4] the kidney is a favorite site for metastases from lymphosarcoma which may take the form of minute foci, bulky masses or diffuse infiltration.

Although diffuse leukemic infiltration of the kidneys does occur in adults, the condition is considerably more frequent in children. Of a series of 50 cases of leukemia coming to autopsy at the Infants' and Children's Hospital, 26 showed the diffuse form of infiltration of the kidneys.

It is conceivable, as in Case 1, that an occasional patient with unrecognized leukemia will be referred for intravenous urography to determine the nature of the large masses within the abdomen. Because of this, and as the roentgen appearance has only occasionally been described, we would like to represent 3 patients with leukemic infiltration of the kidneys, and describe in

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Fig. 1. Case 1. Intravenous urogram fifteen minutes after injection of diodrast showing enlargement of each renal pelvis with marked elongation of the calices and infundibula without actual deformity or filling defect.

detail the rather characteristic picture obtained after the intravenous injection of diodrast.

REPORT OF CASES

CASE 1. L.D., a male infant, aged twenty-three months, was apparently well until seven weeks before admission to the Infants' and Children's Hospital, when small lumps on the head and large masses within the abdomen were noted. These lumps on the head increased in size and number but were never tender and never showed evidence of erythema. The masses in the abdomen were thought to be due to marked enlargement of each kidney. One week before admission, moderate swelling of the parotid gland became apparent. Physical examination on admission revealed multiple, hard nodules in the scalp which were movable and apparently not attached to the underlying periosteum. There was considerable enlargement of the right and moderate enlargement of the left parotid gland. Large, smooth, non-tender masses could be palpated within the abdomen in the position of the kidneys. Examination of the blood on admission showed 5.37 million red blood cells, with 87 per cent hemoglobin; the white blood cell count was 13,200, platelets 179,000 and reticulocytes 2.2 per cent. A differential count of 200 white blood cells showed 36 per cent mature polymorphonuclear leukocytes, 32 per cent "blast" forms, 3 per cent metamyelocytes, 1.5 per cent myelocytes, and 0.5 per cent eosinophils and basophils. There were 7.5 per cent small and 9 per cent large lymphocytes. There were many macrocytic and polychromatic red cells and about 9 per cent of the red blood cells showed definite achromia. The platelets seemed almost normal on the smear. The urine was negative on admission and the non-protein nitrogen was 43 milligrams per cent. The clinical diagnosis was bilateral embryoma of the kidney with metastases, and the patient was referred to the Department of Roentgenology for examination of the skeleton, chest, and kidneys.

Roentgenograms of the chest showed multiple enlarged nodes in the mediastinum; the long bones showed nothing unusual except for multiple growth-arrest lines. The intravenous urogram showed enormous enlargement of each kidney; the enlargement appeared to be symmetrical and the outline of each kidney was smooth. There was no evidence of calcification within either renal shadow. The dye appeared promptly in the five minute film in adequate concentration; each renal pelvis showed considerable enlargement with rather marked elongation of the calices and infundibula without actual deformity or filling defect (Fig 1). No cyst-like defects could be visualized in the outline of the calices to suggest polycystic kidneys. The roentgen diagnosis was diffuse neoplastic infiltration of each kidney, probably leukemic. A biopsy of the scalp was done two days after admission and the diagnosis of leukemic infiltration of the skin and subcutaneous fat of the scalp was made. The cells observed in the biopsy specimen appeared to be well differentiated, somewhat large lymphocytes with a few of the cells resembling lymphoblasts (Fig. 2).

Radiation therapy was given to the enlarged nodes in the chest and one week later the mediastinal shadows were regarded as being within normal limits. Four weeks after discharge the patient was readmitted with symptoms of vomiting, thirst, dyspnea, and marked pallor.

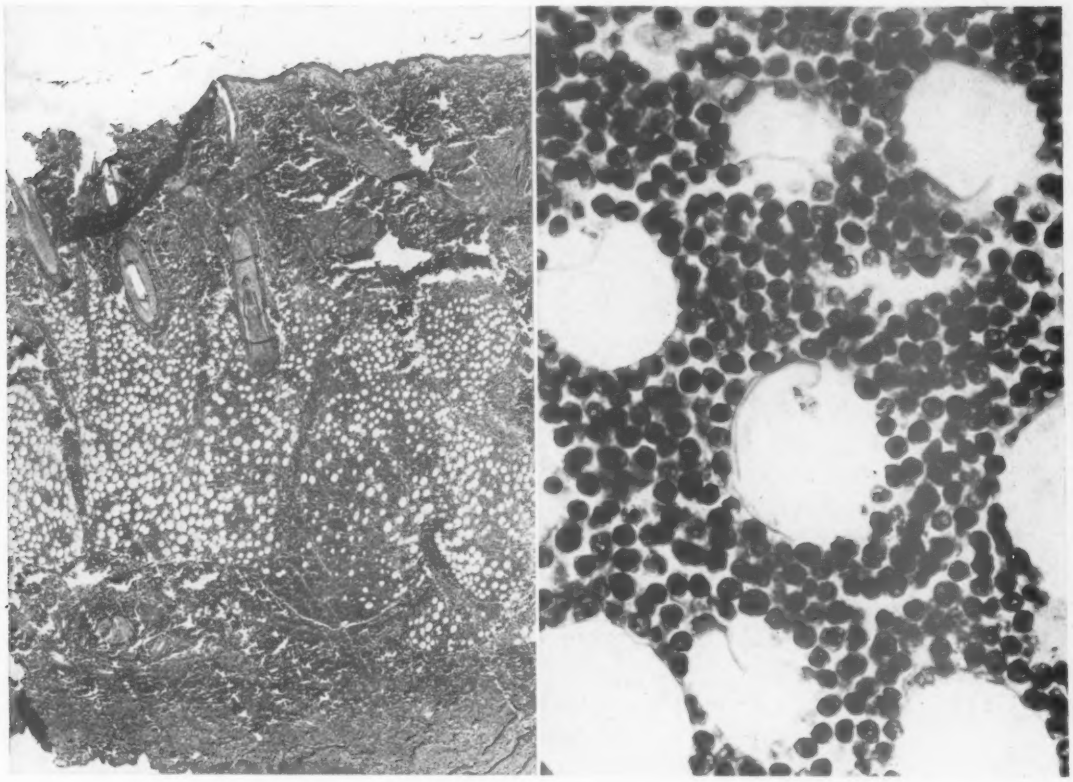

Fig. 2. Case 1. Photomicrograph, leukemic infiltration of the scalp, biopsy.

The child was comatose, there were numerous small hard lumps in the scalp, both parotids were swollen and there were enlarged nodes in the neck, axillae and groins; large bilateral masses were noted in the abdomen. An examination of the blood showed 1.73 million red blood cells and 86,000 white blood cells, the majority of which appeared to be immature lymphocytes of the "blast" type. The patient remained comatose and died five hours after admission. Permission for postmortem examination was not obtained. The final diagnosis was acute lymphatic leukemia.

Case II. D.F., a white female, aged twelve, was admitted to the Infants' and Children's Hospital with a history of weakness, listlessness, and occasional transient chest pain of one year's duration. Five weeks before entry she was noted to be pale and complained of a cough and of feeling feverish. During the month before entry, she had experienced three slight nosebleeds. Physical examination revealed pallor, small, non-tender cervical nodes, a small right axillary node and a moderately enlarged right submaxillary node. The heart was thought to be enlarged with an apical systolic murmur. The spleen was palpable to the midline of the abdomen at the level of the umbilicus and both kidneys felt enlarged and displaced downward. Examination of the blood showed 37 per cent hemoglobin, 2.0 million red blood cells, 2,400 white blood cells with a differential count of 26 per cent polymorphonuclear leukocytes and 74 per cent lymphoid cells, of which 32 per cent were small and 42 per cent immature lymphocytes. The platelets were 113,000 and the reticulocytes 1.2 per cent. The smear showed moderate variation in size and shape of the red blood cells with many macrocytes. The urine was negative except for a moderate amount of albumin on one occasion. The clinical diagnosis was leukemia, lymphoid in type, aleukemic stage.

Roentgen examination of the skull showed nothing abnormal; the long bones showed a hazy band of decreased density at many of the metaphyseal zones that, while nonspecific, is frequently associated with leukemia. A survey roentgenogram of the abdomen showed each

Fig. 3. Case II. Intravenous urogram fifteen minutes after injection of diodrast demonstrating markedly enlarged kidneys with elongated calices and infundibula without evidence of obstruction, filling defect or deformity.

renal shadow to be prominent with the left displaced downward by a large soft tissue mass apparently the spleen. The chest showed nothing abnormal. Intravenous urogram showed prompt appearance of the dye on the five minute film; each renal shadow was markedly enlarged and the calices and infundibula elongated with no evidence of obstruction, filling defect or deformity (Fig. 3). The roentgen diagnosis was diffuse neoplastic infiltration of each kidney, compatible with leukemic infiltration.

On the nineteenth hospital day a sternal biopsy showed leukemia of the bone marrow which was diffusely cellural with uniformity of cell pattern, the cells being large, with large oval or vesicular nuclei, of the lymphocytic series (Fig. 4).

The patient was treated by transfusions and discharged home three weeks after admission. She died at another hospital five weeks later following two weeks of care there for marked dyspnea, generalized pain and weakness. No autopsy was obtained.

Case III. F.L., a white female, aged eight, who for one year before admission to the Children's Hospital, was noted to be pale, easily fatigued, and to have occasional nosebleeds. She was given iron for her anemia and was said to have improved markedly. Two months before admission, she again became pale, weak, and easily fatigued with frequent nosebleeds, bleeding from the gums and easy bruising. Iron therapy had no effect. Physical examination revealed an extremely pale girl, with one ecchymosis and several petechiae. The heart was moderately enlarged with a soft systolic murmur. There were large hard masses in the upper abdomen on each side, which were first identified as liver and spleen. Examination of the blood showed 24 per cent hemoglobin, 1.53 million red blood cells, 5,950 white blood cells, and 32,000 platelets. The differential count revealed 9 per cent polymorphonuclear leukocytes, 1 per cent myelocytes, 0.5 per cent premyelocytes, 36 per cent small lymphocytes, and 10 per cent were listed as "blast" forms. The reticulocytes were 1.6 per cent. Very few platelets were seen on the smear but the red blood

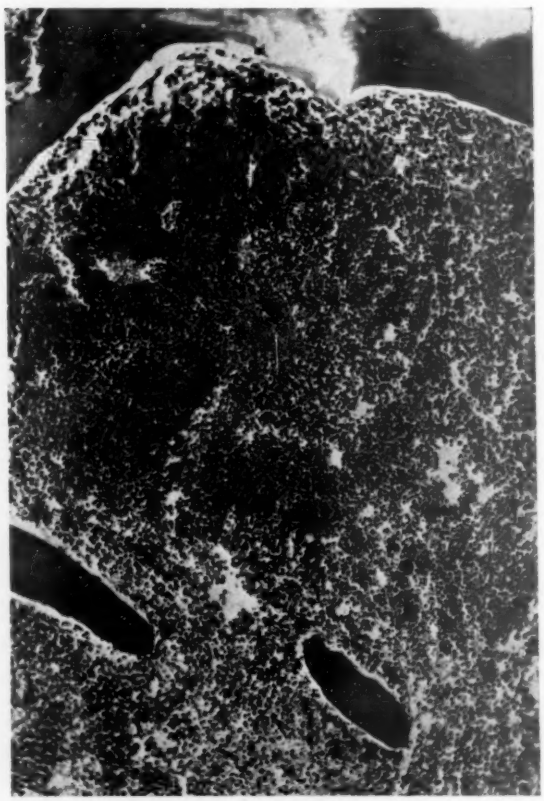

Fig. 4. Case II. Photomicrograph showing leukemia of the bone marrow.

cells in general appeared well filled with hemoglobin and showed moderate variation in size and shape. The bleeding time was greatly prolonged, clotting time was normal, as was the icteric index. Urinalyses showed an occasional small amount of albumin, rare red cells, and an occasional white cell. The serum protein was 6.3 grams, the serum non-protein nitrogen was 37.5 mg. per cent. A stool guaiac test was 2 plus on admission.

On the sixth hospital day, it was noted that, in addition to an enlarged liver, there was a large, round, hard mass in the right kidney region, and the patient was referred to the Department of Roentgenology. Roentgenograms of the skull and long bones revealed no definite abnormality. There was moderate cardiac enlargement, the lungs were clear, and there was no mediastinal lymphadenopathy. A survey roentgenogram of the abdomen showed considerable enlargement of the liver with an enlarged left lobe displacing the stomach to the left; the splenic shadow was not enlarged. Intravenous urogram showed marked enlargement of each renal shadow with considerable enlargement and elongation of the calices and infundibula (Fig. 5).

Fig. 5. Case III. Intravenous urogram on admission. Extreme enlargement of each kidney and elongation of calices and infundibula.

Fig. 6. Case III. Intravenous urogram five days after radiation therapy (350 r) to left kidney. Slight diminution in size is evident.

Repeated blood examinations showed essentially the same picture. The clinical diagnoses considered were acute lymphatic leukemia, thrombocytopenic purpura and polycystic kidneys. It was believed the entire picture could be explained on the basis of leukemia with leukemic infiltration of the liver and both kidneys. Accordingly, it was decided to administer roentgen therapy to the left kidney, shielding the right. During the third and fourth week of the hospital stay, a total of 350 roentgens was given to the left kidney with the following factors: 200 kv., 10 ma., 1.0 mm. Al plus 0.5 mm. Cu filter, 50 cm. distance, half-value layer 1.05 mm. Cu.

An intravenous urogram five days after completion of therapy showed the left kidney and calices to appear slightly smaller, indicating that the renal enlargement was due to radiosensitive tissue (Fig. 6). During the hospital stay the patient was given several transfusions, but continued to have occasional nosebleeds, small petechiae, and on one occasion a right retinal hemorrhage. She was discharged one month after admission with a diagnosis of leukemia, leukopenic, lymphatic.

Fig. 7. Case III. Intravenous urogram five weeks after radiation therapy to left kidney. There is marked decrease in size of left kidney, pelvis and calices.

This child was admitted again three weeks later because of spontaneous epistaxis; blood examination at this time showed 47 per cent hemoglobin, 2.25 million red blood cells, 2,850 white blood cells, with a differential count of 15 per cent polymorphonuclear leukocytes, 70 percent lymphocytes, and 15 per cent "blast" forms. The platelets were 112,000. An intravenous urogram during this admission, five weeks after radiation therapy, showed slight decrease in the size of the right kidney, and a rather marked decrease in the size of the left kidney and calices (Fig. 7).

Following arrest of the epistaxis, several transfusions were given and the patient discharged. She died at home, and a postmortem examination was not done.

The essential feature of leukemia is a neoplastic proliferation of the lymphoblastic or myeloblastic tissues of the body, often with resulting increase in the white blood cells in the peripheral blood stream. There may be proliferation of these white cells in the reticulo-endothelial tissues, but they do not necessarily have to appear in any great numbers in the blood; such a state is called aleukemic leukemia, which is to be considered a phase of the leukemic state. It may be impossible to distinguish sharply between lymphatic leukemia and lymphoblastic lymphoma or lymphosarcoma for a leukemic blood picture may become apparent in the latter conditions at some stage in their course. The appearance of abnormal lymphocytes in the circulating blood (leukemia) may be regarded as an overt manifestation of the underlying disease (lymphoma). In lymphatic leukemia, some myeloid cells may appear in the peripheral blood as a result of bone marrow irritation by lymphoid deposits; a secondary anemia occurs when marrow replacement reaches a severe degree and for a similar reason blood platelets are usually diminished.

Acute leukemia in childhood presents little difficulty when typical clinical and hematologic manifestations are present. Atypical manifestations may obscure the picture to such an extent that the diagnosis becomes more difficult. As a rule, the diagnosis of leukemia is definitely established by blood and bone marrow smears; the marrow reveals the true picture of the disease and by comparing its cells with those of the peripheral blood, the course of the leukemic process can be followed. The acute form of aleukemia is occasionally mistaken for essential thrombocytopenic purpura especially if there is evidence of hemorrhage, anemia, and decreased platelets, a prolonged bleeding time and a normal clotting time. In the latter condition, there is usually a slight to moderate leukocytosis with an increase of polymorphonuclear forms and no abnormal cells in the peripheral blood. Aplastic anemia in children is rare; blood findings similar to those in aleukemic leukemia may be present but reticulocytes are usually absent in aplastic anemia, and the lymphocytes are all mature forms. Sternal or lymph node biopsy should establish the correct diagnosis.

Two of our cases showed an aleukemic

picture and all 3 cases presented a thrombocytopenia, the latter being quite marked in Case III (F. L.) who presented hemorrhages from the mucous membranes into the skin and a retinal hemorrhage. Each child showed a secondary hypochromic anemia, although in 1 case (Case I) this was not marked until the second admission. Each patient showed a neutropenia and a lymphocytosis, with abnormal white cells in the peripheral blood. There was splenomegaly in 1 case (Case II), hepatomegaly in another (Case III), and mediastinal lymphadenopathy was discovered by roentgen examination in 1 child (Case I).

According to Minot and Isaacs[10] lesions of the various types of lymphoblastoma are known to develop within the abdomen as a late manifestation of the disease; frequently the abdomen may also be the site of the initial lesion of lymphatic leukemia in its aleukemic form. Abdominal masses were detected in 42 (35 per cent) of 119 patients with initial symptoms referable to lymphoblastoma of the abdomen. Abdominal masses occurring early in the course of the disease may be considered as an indication of a rapid advancement of the disease to the abdomen from other parts; however, lesions due to lymphoblastoma may exist in the abdomen for many months without giving rise to symptoms or signs. After the appearance of symptoms referable to an abdominal lesion, prognosis for long duration of life is poorer than when such manifestations are absent.

Fig. 8. Diffuse leukemic infiltration of the kidneys in situ, from an autopsy of a child three and a half years old. The right kidney weighed 428 grams (normal 89) and the left 462 grams (normal 77).

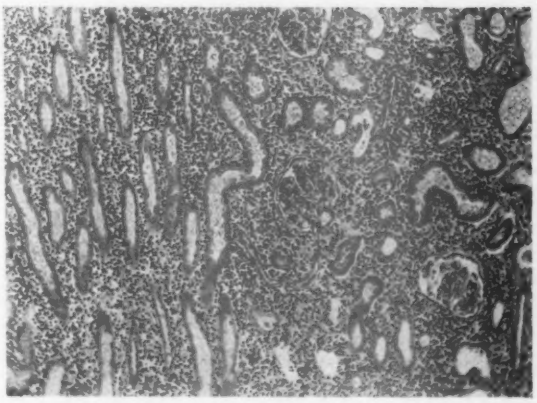

Fig. 9. Photomicrograph showing diffuse leukemic infiltration of the kidney.

The kidney of diffuse leukemic infiltration is slightly to markedly enlarged, often as much as three to four times normal size, occasionally even larger (Fig. 8). It is soft to firm, rather greasy in consistency, usually with gray or grayish-pink surfaces which frequently show mottled deep brown to red areas of discoloration as a result of hemorrhage. The capsule usually strips easily but may be somewhat adherent as a result of capsular and pericapsular infiltration. The cut surface of the kidney is usually pale gray or pinkish, may show areas of hemorrhage and there may be loss of distinctness of the cortical and medullary structures. Microscopically, the individual nephrons are widely separated by massive cellular infiltration (Fig. 9). The infiltration is most marked in the cortex and usually decreases steadily as the pelvis is approached. There is compression and sepa-

ration of the tubules and there is often a certain degree of tubular degeneration. The glomeruli may be well preserved or show degenerative changes. The leukemic infiltration may be so extensive that relatively few glomeruli and tubules may be seen in any one microscopic field. Areas of extravasation of blood may be seen and there may be infiltrations of the capsule, perinephric fat and pelvis. If there is a full blown leukemic blood picture, the renal blood vessels may be seen stuffed with white blood cells, some of which may even be identifiable as immature cells. The glomerular tufts may be seen to contain an abnormal number of white cells. In the aleukemic state, the contents are usually not remarkable.

The roentgen picture following intravenous urography seems rather characteristic.

In our 3 cases of diffuse leukemic infiltration of the kidney the involvement was bilateral in each instance and there was moderate to marked, symmetrical enlargement of each kidney. The renal pelves were considerably enlarged without dilatation or other evidence of obstruction; the calices and infundibula were elongated without real deformity, filling defects, displacement or irregularity of outline. The appearance of the kidneys visualized roentgenographically is quite readily appreciated when correlated with the gross and microscopic structural changes, the extensive cellular infiltration producing renal enlargement and separation of the parenchymal elements, spreading, separation and elongation of the calices and enlargement of the pelves. Any displacement of the kidneys is due to attendant hepatomegaly or splenomegaly, or retroperitoneal lymphadenopathy, a result of the same leukemic process which can be visualized roentgenographically. Other lymphadenopathy may be present, although often this may be mediastinal and only detected by roentgen examination. The blood picture should show the characteristic findings of leukemia, but in instances in which there is a normal or subnormal white blood cell count a careful examination of the peripheral blood should be made for abnormal cells. Lymph node biopsy or sternal marrow biopsy may frequently be of distinct value in determining the nature of the underlying neoplastic process. Of interest and value is the prompt regression of lymphomatous lesions after relatively small doses of radiation, as demonstrated in one of our cases (Case III).

Mention should be made of the occurrence of renal failure in leukemia as recorded by Merrill and Jackson.[9] It may be due to leukemic lesions with glomerular and tubular degeneration, obstruction of the renal blood vessels or ureters by leukemic tissue, nephrolithiasis or non-leukemic degenerative changes. However, in the 3 patients reported here tubular function as judged by diodrast clearance was excellent.

Roentgenographically, the appearance of diffuse leukemic infiltration of the kidneys is apt to be confused with the picture produced by polycystic kidneys. Diodrast clearance is usually markedly diminished in polycystic kidney and the characteristic multiple rounded filling defects that deform the pelvis, infundibula, and calices should be evident.

Occasionally Wilms' tumor may be bilateral and produce extreme enlargement of the kidneys.[8] We have not seen an embryoma produce the diffuse types of infiltration that is produced by leukemia, although such is a possibility.

SUMMARY

1. Infiltration of the kidneys is frequently found at postmortem in patients dying from leukemia.

2. Occasionally marked enlargement of the kidneys is the presenting sign in a patient with unsuspected leukemia. In such a patient, the diagnosis may be inferred by roentgen examination after the intravenous injection of diodrast.

3. The roentgen appearance seems characteristic but may be confused with that produced by polycystic kidneys.

4. Leukemic infiltration may produce extreme enlargement of the kidneys with marked elongation of the pelvis, infundibula, and calices. Diodrast clearance is well preserved, and there is no evidence of multiple rounded pressure defects.

5. Roentgen irradiation should produce diminution in the size of the infiltrated kidneys.

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LARYNGEAL CHONDRONECROSIS FOLLOWING ROENTGEN THERAPY*

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CHONDRONECROSIS of the larynx after roentgen therapy for laryngeal cancer is precipitated by infection of cartilage with lowered radioresistance. This lowered radioresistance may be due to invasion by cancer or reduced vascularization as, for example, after partial laryngectomy, previous intensive radiotherapy, or preceding disease. Healthy laryngeal cartilage protected by normal mucosa and perichondrium will withstand the infection which is always present in the larynx and will usually tolerate modern fractionated therapeutic roentgen-ray dosage. According to Gates[4] "adult cartilage stands large amounts of radiation without marked gross change so long as it is protected. When it is infected or traumatized, extensive necrosis and sequestration may occur." Chondronecrosis is exceptional in superficially fungating early and small carcinomas. It is commoner in more advanced and extensive growths, especially if they have a tendency to invade the subjacent tissues and thus obstruct the flow through the venous and lymphatic capillaries, causing edema of the mucosa. The edematous mucosa tends to ulcerate superficially affording access for bacteria to deeper tissues. The infection spreads to the perichondrium. The resulting perichondritis interferes with the nourishment of the cartilage and chondronecrosis ensues. A similar train of events, however, may occur without roentgen therapy, solely as result of progressive infiltration of the cartilage by cancer.

Following radiation treatment it is often impossible, clinically, to differentiate between chondronecrosis due to infiltration by cancer and one due only to the radiotherapy. Probable absence of cancer may be assumed if a sufficiently long period of clinical freedom from cancer has elapsed between the chondronecrosis and the follow-up examination. The roentgen-ray reaction during and after the course of fractionated roentgen therapy is similar in patients developing chondronecrosis and successfully treated patients. Slight edema of the laryngeal mucosa, especially over the arytenoids, is often seen during the course of roentgen therapy for cancer of the larynx. This edema becomes more pronounced after one-half to two-thirds of the dosage has been given, again at the conclusion of therapy and usually subsides within four to six weeks after the radiation treatment. In patients who develop perichondritis and chondronecrosis, the edema may persist or recur soon after conclusion of the reaction. In time the edema becomes more pronounced. The laryngeal structures become extremely swollen and distorted. Narrowing of the airway frequently makes tracheotomy necessary. With the onset of frank chondronecrosis, the breath becomes foul. Pieces of sequestrated cartilage as, for example, in chondronecrosis of the epiglottis may fall into the ventricle and be expectorated; they may accumulate in a depression as, for example, in chondronecrosis of the arytenoids, or be aspirated. Aspiration pneumonia or lung abscess may follow. The patient may die either of pulmonary complications, sepsis, or gradually increasing cachexia due to absorption from the necrotic area.

Microscopically, heavily irradiated carti-

* Presented at the Forty-eighth Annual Meeting, American Roentgen Ray Society, Atlantic City, N. J., Sept. 16–19, 1947.

lages are likely to be devoid of osteoblasts and osteoclasts, whereas non-irradiated cartilage does not show these changes. In determining whether or not there is persisting cancer, even microscopic examination may be inconclusive, unless the entire larynx is available for study, as for instance after laryngectomy or at postmortem examination. If a single biopsy is done, it is not uncommon to find that the cancer has been missed entirely, or that only a piece of necrotic material has been obtained, from which a definite diagnosis cannot be made.

We have not seen any definite indication that biopsy has precipitated chondronecrosis in ulcerated cancers of the larynx. In a non-ulcerated, heavily irradiated mucosa, however, biopsy might open channels for the entrance of infection and thus lead to chondronecrosis. Because of this, post-irradiation biopsies in this type should not be undertaken lightly.

CLINICAL MATERIAL

Laryngeal chondronecrosis following roentgen therapy for cancer of the larynx occurred in 28 of 205 cases treated at the Presbyterian Hospital, New York, between 1932 and 1946. Patients with gross clinical evidence of persisting cancer were not included in this study.

Eight cases of chondronecrosis were apparently free from carcinoma. In 4 postmortem examinations, and in 2 laryngectomy specimens, microscopic study of the larynx failed to reveal persisting cancer. The interval between the last roentgen treatment and microscopic examination in the 4 dead patients was four to nine months and in the laryngectomy cases five and eighteen months. The 2 remaining patients have been free from clinical evidence of cancer eight and fifteen years, respectively, after treatment. It may be assumed, therefore, that in these cases the cancer had been destroyed before the occurrence of chondronecrosis or that it was completely carried away with the slough.

Two patients showed persisting cancer on biopsy of the larynx. It is not known whether cancer persisted in the remaining 18 cases.

The occurrence of chondronecrosis seemed to be influenced by the following factors: the interval between the last roentgen treatment and occurrence of chondronecrosis, the site and extensiveness of the cancer prior to the chondronecrosis, partial laryngectomy prior to irradiation and the technique of treatment.

Interval between Roentgen Therapy and Chondronecrosis. Chondronecrosis usually developed within six months from the time treatment was finished, as seen in Table 1.

Table I

Interval	Number Cases of Chondronecrosis
Within 6 months after the last roentgen treatment	23
Six months to a year after the last roentgen treatment	2
Over one year after the last roentgen treatment	3

Site of Chondronecrosis. The site of the chondronecrosis was known to be limited in 2 patients to the epiglottis; in another to the thyroid cartilage. The remainder, however, showed such extensive necrosis when first seen that it was difficult to ascertain its point of origin.

Of the 28 cases, 17 showed preceding fixation of the arytenoid, suggesting that this may have been a frequent initial site of the chondronecrosis in this series.

Hautant, who followed 200 carcinomas of the larynx treated by Coutard, stated in 1927 that the lower angle of the anterior borders of the thyroid cartilages was in his experience the most common site of radionecrosis. The anterior borders of the thyroid cartilages which are joined at an acute angle form the narrowest portion of the larynx; thus they are exposed to the largest roentgen-ray dosage when the larynx

is cross-fired from each side. Chondronecrosis of the thyroid cartilage did not appear to be the most frequent site in the present series of cases.

Chondronecrosis occurred in a higher proportion of cases of cancer of the epiglottis than in cancer arising in any other site in the larynx. Most cured cancers of the epiglottis show a deformity of the cartilage indicative of a healed area of chondronecrosis. If small, such deformity is usually not recognized. In the present series 25 carcinomas of the epiglottis have been treated since 1932; 6 of these developed marked chondronecrosis. The epiglottis lies directly beneath the mucosa and is invaded early in the course of the disease. Gross necrosis occurred in only 1 case in which the disease was limited to the free portion. This occurred eight years after treatment.

Extensiveness of Cancer and Chondronecrosis. The extensiveness of the cancer had a definite influence on the occurrence of chondronecrosis, as seen from Table II. There was only 1 case in which the disease was of limited extent—on the free portion of the epiglottis.

Table II

Site of Cancer	Number Cases of Necrosis
Confined to vocal cord	0
Vocal cord* with extension	16
Confined to epiglottis (free portion)	1
Epiglottis with extensions	5
Extensive cancer—primary unknown	6
	28

* Arytenoid fixed—11.

Partial Removal of Thyroid Cartilage and Chondronecrosis. Roentgen therapy after laryngofissure was done in 7 patients. Two of the 7 cases developed chondronecrosis.

One hemilaryngectomy was done two weeks after a tumor dose of 7,800 roentgens. The removed portion of the larynx showed only radiation reaction without evidence of necrosis or persisting carcinoma. After the operation chondronecrosis developed promptly in the remaining portion of the larynx. Another patient had partial bilateral removal of the thyroid cartilage before roentgen therapy and developed chondronecrosis of the remainder of the cartilage. Partial resection of the thyroid cartilages associated with operations on the intrinsic larynx prior to roentgen therapy has, in our experience, increased the likelihood of chondronecrosis developing in the remaining cartilages. The scarring and impairment of the blood supply in our cases has appeared to reduce the tolerance of the larynx to roentgen therapy and to infection.

In contrast to our experience, Arbuckle reported 18 cases of advanced laryngeal cancer in which he subperichondrially resected the thyroid cartilages before roentgen therapy. Of these cases, 7 were living without evidence of local cancer one to eight years after treatment. His operation varies from any of our operated cases in that *the cartilage alone is removed, the perichondrium is left intact* and the laryngeal cavity is not entered, avoiding contamination of the operative field. When this precaution is not observed the tendency to chondronecrosis seems to be increased by partial removal of the thyroid cartilage. Arbuckle further states that the laryngeal function is not impaired because of the firm fibrous structure which replaces the removed cartilage. Roentgen therapy in his cases was started two weeks postoperatively.

Technique of Treatment and Chondronecrosis. The technique of roentgen therapy in the cases of chondronecrosis on the whole did not differ from that used in cases which did not develop this complication. One gained the impression, however, that the larger the fields and daily dose and the shorter the period of treatment, the more frequently did laryngeal edema appear after the therapy. Marked laryngeal edema in its turn at times was a precursor of chondronecrosis. In this connection it might be recalled that in the early days of

200 kv. roentgen therapy of cancer of the larynx, extensive radiation fields and large fractions of the total dose or even single massive treatments were given. For instance, Jüngling warned against roentgen therapy of operable cancer because of the danger of roentgen-ray damage to the larynx. However, he administered about 1,000 r each to a right and left lateral laryngeal field at a single exposure and repeated this intensive treatment once or twice at monthly intervals. In our early cases daily doses of 400 r to one field were not uncommon. All surface doses in this article are stated as "dosage in air" unless otherwise specified.

Of the 28 patients who developed chondronecrosis, 14 received a tumor dose of 5,500 to 6,000 r. Ten cases were given tumor doses of 6,000 to 7,000 r. In passing, it is interesting to note that the tumor doses in 21 patients with cancer of the larynx, similarly treated and now free from clinical evidence of cancer for five years, varied from 5,500 to over 8,000 r.

The treatment time in the cases with chondronecrosis varied from seventeen to fifty-one days, the majority being treated in from thirty to forty-five days. The latter is the period now usually employed for the treatment of most cases of carcinoma of the larynx at the Presbyterian Hospital.

The daily dosage was usually 100 to 150 r to each of two opposing lateral laryngeal fields, but was 400 r to one field in nearly one-third of the cases. In a few cases in which marked edema was present prior to the treatment, the initial dosages were as low as 50 r. The size of the radiation fields were usually 6 by 8 or 8 by 10 cm. and varied in a few cases from 4 by 5 to 10 by 15 cm. These technical factors did not differ materially from those used in patients receiving roentgen therapy for laryngeal cancer, who did not develop chondronecrosis.

The doses in most cancers of the larynx receiving roentgen therapy at the Presbyterian Hospital vary between 6,000 and 7,000 r in air in six weeks. The two lateral fields, one on either side of the larynx, are directed somewhat obliquely toward the larynx, with a strip of unirradiated skin 1 cm. or less in width left in the center anteriorly, except in anterior commissure lesions in which the fields may overlap. Two hundred kilovolts, 2 mm. of copper or Thoraeus filter and 50 cm. target-skin distance are used, and a daily dose of 100 r to each of the two lateral fields is administered. The size of the fields vary from 4 by 5 to 8 by 10 cm., 6 by 8 cm. being the most common. If cervical nodes are present they may be treated over separate fields. The center of the larynx is estimated as being approximately 3 cm. from the center of each treatment field and tumor doses are thought to be almost equal to the sum of the air doses administered to each side except if the fields are smaller than 6 by 8 cm.

The reactions during treatment vary moderately with different individuals. Treatment is interrupted after 1,400–1,800 r in air to each of the two fields, if a pseudodiphtheritic membrane develops on the irradiated mucosa, and is resumed after a few days, when the membrane begins to subside. If the initial membrane does not develop until after 2,500 r has been given to each field, treatment if possible is not discontinued but is carried to completion, i.e., a minimum of 3,000 r to each field. The treatment may occasionally be interrupted after one-half to two-thirds of the total dose has been administered to allow the radiation edema to subside. In those cases in which the extent of the disease and associated edema cause an inadequate airway, tracheotomy may be done before treatment. In these cases, treatment may be given more slowly at first, i.e., 50 to 75 r in air daily to each field, up to a total of 400 to 500 r in air. At this time the local inflammatory reaction will often have subsided and the danger of obstructing the airway will have been reduced.

If treatment is successful, the membrane clears, the edema subsides and all local evidence of the carcinoma disappears. Some edema of the arytenoids may persist. This

is especially common if more than 1,000 r has been given with fields 8 by 10 cm. or larger. This late edema occurs chiefly in extensive cases and may persist for a number of months even in cured patients. It may be subject to moderate episodes of increased severity, secondary to upper respiratory infections or injudicious use of the voice or tobacco. Fixation of the arytenoids may be permanent even in cured cases. Though absence of gross evidence of disease usually means arrest of the cancer, it does not necessarily guarantee a cure, as microscopically persisting carcinoma may become clinically appreciable within a few weeks, months or years after treatment.

PROGNOSIS

The extent, the location and the time of onset of the chondronecrosis influence the outlook for healing.

Chondronecrosis of the free portion of the epiglottis has a much more favorable prognosis than necrosis of other laryngeal cartilages. Virtually every case of cancer of the epiglottis arrested by roentgen therapy has a residual deformity following treatment, which implies previous destruction of the affected part of the cartilage. This takes place in the successful case without ensuing necrosis of the remainder of the cartilage. The downward drainage from the epiglottis allows sequestra to slough out into the ventricle whence they are promptly coughed up. Extension of the necrosis to the base of the epiglottis or to the pre-epiglottic space is much more grave and recovery here is rare.

Chondronecrosis in the region of the arytenoid cartilage also has a bad prognosis. Here, the necrotic ulcer forms a depression from which it is difficult to dislodge sloughs and sequestra as drainage is upward and as this cavity cannot be emptied by coughing. Absorption from this necrotic area, cachexia, aspiration pneumonia and lung abscess may result. We have seen only a few chondronecroses of the thyroid cartilages, all in extensive carcinomas and all these cases dead.

The time of onset of chondronecrosis in the present series seemed to be of prognostic importance. This is contrary to the experience of Van Rosen who reported recovery in 9 of 23 cases of perichondritis and chondronecrosis of the larynx following irradiation. In 5 of these 9 cases symptoms suggesting perichondritis appeared in less than one year and in 4 more than one year after treatment.

In the present series of cases in those developing chondronecrosis early, there was greater likelihood of persisting carcinoma. The extent of necrosis of the soft tissues was generally greater and healing either after sloughing of the necrotic cartilage or after its surgical removal was not as good as in the "late" cases, which seemed to progress more slowly and not so far.

Of the 28 cases of laryngeal chondronecrosis 23 developed within six months, 2 within one year and 3 over a year after the last roentgen treatment. The 3 patients developing chondronecrosis more than one year after treatment recovered: 1 after laryngectomy, 1 after removal of the necrotic portion of the epiglottis, and the third after sloughing of the necrotic cartilages.

PREVENTION AND TREATMENT OF LARYNGEAL CHONDRONECROSIS

In the preceding paragraphs it has been shown that laryngeal chondronecrosis after roentgen therapy occurs chiefly in cartilage with lowered radioresistance and is precipitated by the entrance of bacteria into this cartilage. In such cases, therefore, it would seem logical to substitute surgery for roentgen therapy, where practical, and also to try to reduce infection prior to irradiation, if the use of roentgen therapy cannot be avoided. It will be remembered that chondronecrosis was more common in extensive, infiltrating cancers, occurred more readily after partial laryngectomy and though most common in the epiglottis was serious chiefly when involving the base of this cartilage, the arytenoids or thyroid cartilages. We believe that impending chondronecrosis may in rare instances be aborted by the use of sulfonamides and penicillin,

but once established it is influenced much less. In several extensive carcinomas of the larynx with marked infection prior to roentgen therapy and marked edema after treatment, we believe we prevented the full development of chondronecrosis by the use of 250,000 units of oral penicillin daily for a week or two, and saw the gradual regression of the edema and return to a more normal looking larynx.

While the total removal of the cartilage by laryngectomy makes chondronecrosis impossible, the subperichondral removal of the cartilage, as proposed by Hautant and recently by Arbuckle, may also offer hope of avoiding this complication.

As far as the *technique of roentgen therapy* is concerned, it is our impression that doses of roentgen rays much larger than 100 r, in air, daily to each of two lateral 6 by 8 cm. fields with the usual 200 kv., 50 cm. target-skin distance, 0.5 mm. Cu filter, are preferably not carried further than 500 r or at most 1,000 r to each field, for fear of causing later edema of the larynx and thus perhaps favoring radionecrosis. With smaller fields slightly larger daily doses may be given. In discussing this point with some advocates of much higher daily dosage and shorter over-all treatment period, we have gained the impression that the survival rate from this more rapid method is no better, and the likelihood of edema and chondronecrosis greater, than when the daily doses are less and the treatment period five to seven weeks. The use of unnecessarily large fields should be avoided if smaller fields will include the entire cancer. Irradiation of large volumes of normal tissue increases the likelihood of edema, chondronecrosis and later irradiation sequelae. In extensive cancers large fields cannot be avoided and the over-all period might be increased in order to prevent severe radiation reaction. Tracheotomy when indicated should be made below the irradiated area, as otherwise this may precipitate chondronecrosis by permitting the entrance of bacteria into irradiated and damaged cartilage.

Local resection of the necrotic portion of an epiglottis was done in 1 patient who recovered.

Laryngectomy for removal of the chondronecrotic larynx has been performed in 3 of our 28 cases. Each had received a tumor dose of 6,000 r in six to eight weeks. Tumor persisted locally in the first case and could not be found in the second and third cases. The first patient was a male, aged fifty-four, with a cancer of the true cord, for which an unsuccessful laryngofissure and cordectomy had been done three years, and an unsuccessful hemilaryngectomy one year, before roentgen therapy. Because of persisting tumor, complete laryngectomy was performed five months after the end of roentgen therapy. Advanced necrosis was present at operation. The wound sloughed, and the patient died eight days after laryngectomy. The second patient was a male, aged sixty-eight, with an undifferentiated carcinoma of the left ventricular band, interarytenoid space and cord. Persisting edema of the arytenoids followed treatment. Eighteen months after treatment chondronecrosis was considered probable and a laryngectomy was done. The patient recovered, although there developed a hypopharyngeal fistula, necessitating plastic repair. The specimen showed chondronecrosis of the epiglottis, destruction of the left true cord extending into the submucosa, but not to the cartilages. The third patient was a male, aged sixty-nine, with a carcinoma of the left true cord and extension into the false cord and ventricle. Some edema of the laryngeal mucosa occurred during treatment and persisted following roentgen therapy. Four months after treatment a foul odor suggested chondronecrosis and two months later a laryngectomy was done. The operated specimen showed only necrosis without any evidence of cancer. A hypopharyngeal fistula developed necessitating plastic repair. The patient recovered from the laryngectomy but a few months later showed evidence of cancer at the base of the tongue beyond the operative site.

Three patients, not included among the cases of chondronecrosis had *successful*

laryngectomies after full courses of roentgen therapy for cancer of the larynx. In one, with a post-irradiation ulcer of the larynx, two biopsies were negative for cancer while the two others had laryngectomies for persistent cancer, one and five months after roentgen therapy. Both of these patients recovered from the laryngectomy without appreciable delay in healing or other sequelae. These 3 cases and similar experience of others show that healing of the laryngectomy wound may be unimpaired in spite of preceding unsuccessful roentgen therapy for cancer of the larynx.

SUMMARY

1. Twenty-eight cases of chondronecrosis of the larynx following roentgen therapy have been reviewed.

2. Eight of the twenty-eight have been found to be free of cancer. In most of the others it was not possible to determine whether cancer persisted microscopically or whether one was dealing only with radionecrosis.

3. Of the twenty-eight cases, twenty-three appeared within six months, two within one year, three more than one year after treatment; the latter three recovered, one after sloughing, one after local removal of the necrotic portion of the epiglottis and one after laryngectomy.

4. Laryngeal chondronecrosis occurred chiefly in advanced and extensive carcinomas and exceptionally in those which were early and small.

5. a. Chondroncerosis involved the epiglottis more frequently than other laryngeal cartilages. When developing in its free portion prognosis was good, as nearly every cured case of epiglottic carcinoma showed a deformity of the healed radionecrotic area. Prognosis was poor when necrosis extended to the base of the epiglottis or the pre-epiglottic space.

b. The outlook was also poor when the arytenoids or thyroid cartilages were involved.

6. Laryngofissure or partial laryngectomy either before or after a full course of roentgen therapy seemed to favor the development of chondronecrosis in the remaining cartilage. The exception to this was the removal of the necrotic free portion of the epiglottis. Total removal of cartilage by laryngectomy avoided this complication.

7. The use of penicillin and sulfonamides seemed to help to abort the threat of chondronecrosis, but was less effective when chondronecrosis had fully developed.

8. Laryngectomy should be considered in selected cases with early or impending chondronecrosis.

9. Variations in fractionated roentgen dosage as given at the Presbyterian Hospital did not appear to influence the development of chondronecrosis.*

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* For discussion see page 36.

Vol. 60, No. 1

ROENTGEN TREATMENT FOR EXTENSIVE EPITHELIOMA OF THE LARYNX

RESULTS IN 139 CASES*

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GENERAL CONSIDERATIONS

WHEN a patient is afflicted with epithelioma of the larynx, his chance of being cured rests on early diagnosis and early treatment. The earlier the malignant condition can be recognized, the better the prognosis, provided the tumor is completely removed or destroyed before it has become too extensive and before malignant cells have invaded the tributary lymph nodes. When the malignant process is not recognized until it has invaded neighboring structures, tissues or lymph nodes more or less extensively, the chance of curing the patient by any method of treatment diminishes rapidly in proportion to the extent of involvement. Another important factor is the grade of malignancy of the neoplastic process; the greater the degree of malignancy, the more rapidly the tumor tends to grow and to invade adjacent tissues.

Among the malignant tumors which affect the larynx, epitheliomas or carcinomas are by far the most common. These tumors are much more common in men than in women. When the neoplastic condition can be eradicated surgically, a large percentage of patients can be cured. Surgical eradication may consist of oral removal from the epiglottis and adjacent supraglottic portions of the larynx by surgical diathermy after preliminary tracheotomy, of thyrotomy and surgical diathermy for epithelioma of the larynx involving the anterior two-thirds of the vocal cords, of laryngectomy for fixed growths with infiltration of muscle, of block dissection of involved cervical nodes when the neoplasm has a low grade of malignancy, or of roentgen treatment to the cervical nodes when the tumor has a high grade of malignancy.

Of 446 patients on whom operation had been performed at the Mayo Clinic from 1934 through 1943, New and others[3] reported that 213 (47.7 per cent) had undergone laryngectomy; 184 (41.2 per cent) had undergone thyrotomy, and 49 (11.1 per cent) had undergone laryngeal suspension, destruction of the growth by surgical diathermy, and implantation of radon seeds. Of these 446 patients, 90.4 per cent were male and 9.6 per cent were female; 80.9 per cent were from forty-five through sixty-nine years of age, 12.6 per cent were less than forty-five years of age, and 6.5 per cent were older than sixty-nine years.

Of the patients who had undergone laryngectomy and whom New had been able to trace, 60.2 per cent lived five or more years after the operation. In these cases 46 per cent of the neoplasms were epitheliomas of Grade 1 or 2 (Broders' method, and 54 per cent were epitheliomas of Grade 3 or 4. Of the patients who had undergone thyrotomy 83.6 per cent lived five or more years after operation. In 61 per cent of these cases the tumors were epitheliomas of

* Presented at the Forty-eighth Annual Meeting, American Roentgen Ray Society, Atlantic City, N. J., Sept. 16–19, 1947.

Grade 1 or 2, and in 39 per cent they were epitheliomas of Grade 3 or 4. As for the patients who had undergone suspension laryngoscopy, with diathermic destruction of the growth or implantation of radon seeds, 91.7 per cent lived five years or longer after operation, and 82 per cent of these had epitheliomas of Grade 1 or 2. Apparently, the larger percentage of cases in which the neoplasms had a relatively low grade of malignancy had much to do with the high rate of survival. Of this entire series of patients 73.5 per cent lived five years or longer after operation.

When the malignant process was extensive, when cervical lymph nodes were invaded, and when, for these reasons or because the patient's general condition was not good, surgical treatment did not seem advisable or could not be employed, the patients were treated with roentgen rays, often after preliminary tracheotomy.

At one time, years ago, when a patient had an epithelioma of the larynx which was too extensive to be removed or destroyed surgically, the patient's fate was well-nigh sealed, and the prognosis was gloomy indeed. This is no longer true to anything like the same degree. At the present time even rather extensive neoplasms can sometimes be treated effectively; in a certain percentage of cases the malignant process can be made to disappear, and some patients are fortunate enough to remain well. This difference has been brought about by improvements in the technique of roentgen or radium treatment.

The experiments of Regaud[4,5] had shown that, when the testis was exposed, at one time, to a single dose of radium, partial or complete sterilization of the organ ensued, according to the dose of rays; but when the testis was exposed to a small dose of radium and when this was allowed to act steadily for some time, sterilization of the testis was obtained with a much smaller total dose than when the testis was exposed to a single dose at one sitting. Other experiments, which had been carried out by Wood and Prime,[6] had shown that, in order to arrest the growth of an epithelial neoplasm completely, a total dose of roentgen rays equivalent to between three and five times an erythema dose is required.

Coutard[1,2] undertook to apply these principles to the treatment of epitheliomas of the larynx, pharynx and mouth, and the results which he obtained were far superior to those which had been obtained previously. Since then, the method of fractional roentgen irradiation (often called the Coutard method) for epithelial neoplasms has been widely adopted. It is pertinent to mention, however, that the superior results obtained by Coutard and many others, by means of fractional irradiation with large total doses, concerned only carefully selected cases. Some radiologists and certain radiologic institutes have chosen for treatment only cases which were considered favorable; other cases in which the malignant neoplasms were extensive and which, for this reason, were not deemed favorable, were discarded as unsuitable for roentgen or radium treatment.

CASES AND METHOD OF TREATMENT

The purpose of this paper is to review and analyze a series of 139 cases in which epithelioma of the larynx has been treated with fractional doses of roentgen rays from 1936 through 1945. All the patients had extensive epithelioma—in most cases the neoplasms were so extensive that surgical treatment was not considered advisable. Other patients, who had undergone previous laryngectomy here or elsewhere, were suffering from more or less extensive recurrence; and in a large percentage of cases the malignant process had invaded some of the cervical nodes. In many cases respiratory obstruction required preliminary tracheotomy.

Tracheotomy. Among all the patients included in the series of 139 cases tracheotomy was not performed at any time in 56 cases; tracheotomy was performed before roentgen treatment in 76 cases; during the course of roentgen treatment in only 1

case, and soon after the course of treatment in 6 cases.

From the foregoing circumstances it is evident that the cases included in this group could hardly be regarded as favorable; indeed, a more unfavorable group of cases would be difficult to find.

Technique of Treatment. All these patients were treated with rays generated at 200 peak kilovolts, filtered through a Thoraeus filter consisting of 0.44 mm. of tin, 0.25 mm. of copper and 1.0 mm. of aluminum, at a focal-skin distance of 50 cm. The half-layer value was equivalent to 1.75 mm. of copper. In most cases the treatment was given through two lateral fields (one on each side), each of which measured from 8 by 12 cm. to 12 by 18 cm.; but in a small number of cases the treatment was given through three fields (two on one side and one on the other); when two fields on one side were employed, they were on the side on which the bulk of the malignant process was situated.

During the early part of this period, the roentgen treatment was arranged in different ways in an attempt to find the time distribution, the daily dose, and the total dose which would yield the most favorable results. Most of the patients were treated twice a day for periods varying between fifteen and thirty days, but a certain number were treated once a day for a similar period. Except on Sunday, all patients were treated as much as possible on consecutive days; but sometimes, because of radiation sickness or for some other reason, the course of treatment was interrupted, at or near the middle, for one, two, or three days. Six patients were treated for sixteen days, 1 for seventeen days, 1 for eighteen days, 30 for twenty days, 1 for twenty-one days, 2 for twenty-two days, 12 for twenty-three days, 5 for twenty-four days, 65 for twenty-five days, 2 for twenty-six days, 1 for twenty-seven days, and 7 for thirty days.

In 6 cases treatment was discontinued: after ten days in 1 case, after thirteen days in 3 cases, after fifteen days in 1 case, and after sixteen days in 1 case. This had to be done because the patients' condition had become too bad to continue treatment (5 cases) or because the patient refused to carry on (1 case).

The total dose given to each field varied from 2,000 to 4,000 roentgens, measured in air; in most cases the total dose was greater than 3,000 roentgens. Therefore, when the treatment was given through two fields, the total dose for both fields varied between 4,000 and 8,000 roentgens; and when the treatment was given through three fields, the total dose varied between 6,000 and 10,000 roentgens. In normal persons the width, or lateral thickness, of the neck varies between 10 and 16 cm.; but, since most of the patients who were referred for treatment had lost weight, the lateral thickness of their necks varied between 10 and 14 cm. The thickness of the average patient's neck, therefore, is approximately 12 cm. Half this thickness would be 6 cm. With roentgen rays generated at 200 kilovolts and filtered through a Thoraeus filter composed of 0.44 mm. of tin, 0.25 mm. of copper and 1.0 mm. of aluminum, approximately 70 per cent of the air dose would be delivered 6 cm. beneath the skin. Therefore, if an air dose of 3,800 roentgens is given through each of two fields, the total dose reaching the tumor in the middle of the neck would be approximately 5,320 roentgens.

Gradually it was found that there is such a thing as too large a total dose, which causes severe reaction of the mucous membranes and skin without improving the end result. In time it was learned that a total dose between 3,500 and 4,000 roentgens to each of two fields yielded as good results as could be obtained; in the average case such a total dose to each field caused a reaction of the mucous membrane and of the skin which was not unduly severe (moderate epithelitis and epidermitis). In some cases the reaction was only slight, but in a small percentage of cases even this dose caused a rather severe reaction.

The reason why many patients were

treated twice a day was the hypothetical reason of trying to irradiate as many cells as possible during the active phase of mitosis. In all probability it would be impossible to recognize clinically any difference in the biologic effect of irradiating a neoplasm once a day or twice a day, but some hypotheses are so appealing! Another subsidiary reason for irradiating the epitheliomas twice a day was that this might cause less systemic reaction (radiation sickness) than exposure to the same daily dose at one sitting. It is now clear that any difference in this respect is too slight to be perceptible clinically.

Coutard[1,2] and many other radiologists have given total doses of approximately the same magnitude or even larger doses, and they have spread the treatment over a period varying from fourteen to twenty-five or thirty days, and in some cases as long as sixty days. Most patients can tolerate from 200 to 400 roentgens a day without undue disturbance, many can take 300 or 400 roentgens daily without any sign of intolerance, but in some cases even 200 roentgens a day causes the patient to lose appetite or to vomit. In our experience a daily dose between 300 and 325 roentgens is tolerated by most patients, but sometimes the daily dose must be reduced to 250 roentgens or even to 200 roentgens. In some cases, for this reason, the period of treatment has extended over twenty-five days. It is possible that to have shortened the period of treatment to twenty days, or even less, might have improved the results; but this would have required the patients to take a daily dose of nearly 400 roentgens, and almost certainly many patients would have found it difficult or impossible to tolerate this larger daily dose. Even with a daily dose of about 300 roentgens, many patients have lost weight, and sometimes this loss has been considerable.

During recent years some radiologists have advocated treatment through small fields; or, after starting treatment through fields of a certain size, some have recommended reducing the size of the fields as the neoplasms retrogress. No doubt these methods can be used effectively in selected cases, when the neoplasms are not extensive; but in most of the cases with which we have had to deal too small fields would almost certainly have meant that some parts of the malignant process would not have been included or would not have received an adequate dose. In cases of this kind, therefore, the method of diminishing fields would be dangerous. Our attitude has been that, unless the entire neoplasm is treated, the patient might as well not be treated at all. To us, even at the cost of more extensive and more severe reaction, it has seemed preferable—indeed essential—to irradiate through rather large fields in order to avoid the risk of missing part of the malignant process. Even with large fields, we are certain that, in some cases, outlying extensions or infiltrating portions of the neoplasms, or involved lymph nodes, did not receive adequate exposure or were missed altogether.

Tolerance and Reaction. During the first half of the course of treatment, most patients can eat about as usual, and their weight does not diminish much, if at all. But a small percentage of the patients do not tolerate the treatment well, nausea causes their appetite to diminish, and they lose some weight. Sometimes it is necessary, on account of a low tolerance, to interrupt the treatment for two or more days in order to allow the patients to recuperate enough to enable them to complete the course of treatment. In some cases in which the patients have some degree of obstruction and dysphagia it is necessary, for this reason, to insert a tube through the nose into the stomach, and the patients are fed artificially. This seldom occurs during the first half of the course of treatment. When, between the twelfth and fourteenth days, the mucous membrane begins to react (epithelitis), most patients have an increasing difficulty in eating enough food to nourish themselves adequately. Usually this is because the gradually increasing reaction of the mucous membranes causes swallowing to become more and more painful; but sometimes, in cases in which,

before treatment, some degree of obstruction was present, the mucosal reaction causes the obstruction to become complete, or nearly so. It is especially in cases of this kind, and at this stage, that the insertion of a tube for artificial feeding may become an urgent measure. Some patients may lose from 5 to 15 pounds (2.3 to 6.8 kg.), or even more.

After the entire course of treatment has been completed, the epithelitis and epidermitis continue for two or three weeks, slowly subsiding during this period. By this time the neoplasm has retrogressed more or less; and at the same time the patients have less difficulty in swallowing and, as they can take more food, their weight begins to increase. Usually the weight which had been lost before and during the course of treatment, or at least much of this lost weight, is regained within two or three months after completion of the treatment. When, three months after treatment, most of the patients returned for reexamination, most of them had recovered the weight which had previously been lost, their general condition had greatly improved, and the tumor had disappeared. In some cases, however, residual edema made it difficult or impossible to be certain whether or not the malignant process had completely disappeared; and when cervical lymph nodes had been affected more or less extensively, the involved nodes usually had diminished and often they also had disappeared. Sometimes, when lymph nodes in the lower part of the neck had been involved, they did not retrogress as much as nodes high in the neck. In some cases, also, affected nodes in the upper part of the neck underwent only partial regression during the first three months, but complete regression of these nodes occurred later. This, however, was not always true. In most cases, when the involved cervical nodes had not disappeared at the end of three months, complete regression did not occur at any time, and subsequently the malignant process in these nodes again became active.

As has already been shown, the most favorable cases are usually selected for surgical treatment, and only the cases which surgeons consider unsuitable for surgical treatment are referred for roentgen treatment. Some of the patients in this series had undergone operation one or more times, and some had undergone laryngectomy. Others had undergone electrocoagulation, with or without implantation of radon seeds. These were referred for roentgen treatment because further surgical measures were out of the question. Under these most unfavorable circumstances, to expect to cure many patients would be sheer folly, and yet, as will be seen, some patients were cured, and many others derived substantial improvement which continued long enough to be well worth the effort to treat them.

The number of cases included in the series which we are reporting is 139. Among these, 120 of the patients were male and 19 were female. This overwhelming preponderance of male patients agrees with the experience of all those who have written about epithelioma of the larynx. Among these patients 81 were from forty through sixty years of age; of those less than forty years were 1 patient aged thirty-four years, 4 patients aged thirty-five years, and 1 patient aged thirty-eight years. Among those who were older than sixty years, 17 patients fell in the age group from sixty-one through sixty-five years; 14 fell in the age group from sixty-six through seventy years; 13 fell in the age group from seventy-one through seventy-five years; 6 fell in the age group from seventy-six through eighty years; the age of 1 patient was eighty-one years, and that of the oldest patient was eighty-two years. Thus, 52 patients were aged from sixty-one through eighty-two years. Of the total number of patients in this series, the proportion of those whose ages were seventy-one years or more was 15 percent.

Regression of Tumors and of Involved Lymph Nodes. In a large percentage of the cases a course of treatment such as has been described was accompanied by rapid regression of the neoplastic process; by the time the course of treatment had been completed, the tumor had retrogressed so much

that it could no longer be recognized. In other cases the treatment was accompanied by substantial regression, but some of the tumor or secondarily involved lymph nodes could still be seen or felt at the time the course was completed. In many of these cases apparently complete regression required about two months after the end of the course of treatment. By this is meant that, about two months after the course of treatment had been completed, clinical or laryngoscopic evidence of the neoplasm could no longer be found. Three months after treatment, in most cases, some degree of residual edema in the larynx and in the soft tissues of the neck was present in a large percentage of cases. This edema slowly diminished, and usually, but not always, it had disappeared at the end of six or eight months. In a small percentage of cases some edema continued still longer.

As far as the patients' symptoms were concerned, these usually subsided in proportion to the degree of regression of the neoplasm and at approximately the same rate. An interesting point, however, is that even when the malignant process had disappeared, many patients did not recover the normal quality of their voice. Other symptoms, such as hoarseness, cough, dyspnea, or dysphagia, often disappeared or greatly diminished, but many patients were left with a voice which was not entirely normal. Sometimes this was due to the scarring of previously involved larygneal structures after regression of the neoplasm; sometimes, no doubt, it was due to incomplete regression of the malignant process, even when this could no longer be seen; and sometimes it was due to residual edema.

Of the 139 cases a piece of tissue or a lymph node had been removed for biopsy in 126 cases (90.6 per cent). In the remaining 13 cases tissue for biopsy had not been removed, but in all of these the clinical features were such that the malignancy of the lesion could hardly be doubted. Of the 126 cases in which the diagnosis had been confirmed by microscopic examination of sections of tissue not one had a neoplasm with a malignancy of Grade 1 (Broders' method); from this it is apparent that all patients who had tumors with Grade 1 of malignancy were treated surgically. In 41 cases the neoplasms were of Grade 2 malignancy, in 55 cases the tumors were of Grade 3, and in 28 cases they were of Grade 4 malignancy. In 1 case the pathologist who examined sections of tissue from the tumor reported "adenocarcinoma of cylindroma type," and in another case the pathologist reported "Grade 4 neoplasm," without further identification.

RESULTS

Of the 139 patients included in this series recent information was obtained about all but 5 patients. Although information about these 5 patients has not been obtained recently, several of them are known to have been alive and well from one to six years since they were treated. Therefore, we have not hesitated to tabulate them with the other patients, if only to show how long they are known to have survived (Table 1).

In Table 1 the 139 cases are distributed according to how long the patients have survived or when they died since treatment with roentgen rays. From this table it may be seen that 61 patients are known to have died within one year; some of these died soon after treatment (a few weeks or months), and in 1 case the patient died before the course of treatment could be completed. In these cases, obviously, the malignant process had been more than usually extensive, and the general condition of the patients had been bad before the treatment was started. This had been recognized, but treatment had been given nevertheless in the hope of obtaining for the patients substantial, though temporary, improvement. The other 5 patients were living and apparently well when they were last heard from less than one year after treatment; since these patients were treated so recently, however, too much significance cannot be placed on their appearance of well-being at that time.

In some of these cases not only the malignant condition in the larynx had been extensive, but adjacent structures had been

invaded, or lymph nodes in the lower part of the neck had been involved. Under these circumstances, the chance of complete regression was small. When, besides extensive local involvement, the process already has extended to lymph nodes in the upper half of the neck, the prospect of cure is not great. But when, besides the foregoing conditions, lymph nodes just above or behind the clavicle have been invaded, complete regression is practically out of the question.

Table I

DISTRIBUTION OF PATIENTS ACCORDING TO TIME OF DEATH OR SURVIVAL PERIOD

Year Treated	0–1 yr.		1–2 yr.		2–3 yr.		3–4 yr.		4–5 yr.		5–6 yr.		6–7 yr.		7–8 yr.		8–9 yr.		9–10 yr.		10–11 yr.	
	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L
1936	4		2		1											1						2
1937	3				1		1															
1938	4		3															2				
1939	2		2		1									1								
1940	6		2							1		1				2						
1941	8		3		2							1										
1942	6		2	1	3					1		2										
1943	12		3		2		1		1	1												
1944	12	2	8		3	3		1														
1945	4	3	5	5		2																
Total	61	5	30	6	13	5	2	1	1	3		4		1		3		2				2

In some cases it is likely that, besides lymph nodes in the lower part of the neck, which are known to be involved, other nodes which cannot be seen or felt are also affected.

In 30 out of 36 cases the patients are known to have died between one and two years after treatment. When the other 6 patients were last heard from, all were living and apparently well at that time (recently). One of these patients had had exceptionally extensive involvement and how long he may remain well is uncertain. Another of these 6 patients was operated on at least twice after the course of roentgen treatment for reactivation of portions of the malignant process. It is plain that the 30 patients who died in this second group of cases, together with the 61 patients in the first group, who had died within one year, represent a large percentage of the entire series. There is no doubt that these 91 patients had died so soon because the malignant tumors with which they had been afflicted had been most extensive. Undoubtedly the grade of malignancy also had played an important part.

The first impression is one of doubt concerning the advisability of treatment in such unfavorable cases. And yet, the great majority of the patients had obtained substantial improvement. In some cases, within two or three months after the completion of treatment, the neoplastic process had disappeared, and the patients' general condition had greatly improved and often this improvement had continued for many months, to be followed by fresh activity of the malignant condition and by death. In other cases treatment had not caused the primary neoplasms and their secondary extensions to disappear completely, but marked regression and general improvement had occurred, and this had continued for a variable period. When, for from several months to two years, treatment is followed by marked or complete abatement of symptoms and by pronounced improvement in general condition, no one can question its value. After all, complete and permanent cure is not the only criterion of a

method of treatment; in truth, this criterion is valid only in carefully selected and favorable cases. To practice medicine means not only to try to cure patients when this is feasible, but also to relieve suffering in any form when a cure is impossible.

Five patients are known to have survived between two and three years, 1 has thus far survived between three and four years, and 3 are living and well between four and five years. Four are living and well between five and six years, 1 is living and well between six and seven years, 3 are living and well between seven and eight years, 2 are living and well between eight and nine years, and 2 patients are living and well between ten and eleven years.

From Table I it may be seen that, out of 139 cases in the entire series, 71 patients were treated between 1935 and 1942, inclusive; of these we have not been able to obtain recent information concerning 3 cases. This leaves 68 patients in this series who were treated during this period and who are living more than five years since their treatment at the Clinic. As percentages of "cured cases" go, this proportion is not as high as might be expected but, considering the initially unfavorable character of all these cases and the extensive malignant neoplasms from which the patients suffered, even this percentage seems worthy of consideration. There is no doubt that, if these patients had not been treated in the manner which has been described, all of them must inevitably have died in a very short time. Moreover, this percentage does not give any idea of the pronounced relief of symptoms and improvement in general condition which, in the patients who have died, had occurred after treatment.

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DISCUSSION OF PAPERS BY DRS. GOODRICH AND LENZ, AND DRS. DESJARDINS, FIGI AND VAUGHAN

DR. LOUIS H. CLERF, Philadelphia, Pa. I am happy to have the opportunity to discuss these two interesting contributions. Chondronecrosis has always been one of the unhappy complications of radiation therapy, but fortunately we do not see it nearly as often now as in previous years.

I agree with the first speaker regarding not irradiating patients who have been operated upon by laryngofissure and partial laryngectomy and where cartilage remains. I have had several unhappy experiences in this field. We selected laryngofissure plus irradiation and ended up with marked edema of the larynx, partial loss of cartilage, and permanent tracheotomy. I believe it safer if the surgeon selects a more radical procedure, and if surgery is elected, then dispense with irradiation. The end result will be infinitely better.

Drs. Goodrich and Lenz also mention removal of cartilage preliminary to irradiation. That has been done quite extensively in this country by Dr. Arbuckle of St. Louis, and his preliminary reports seem to be encouraging. The question has arisen whether it would not be better, when doing surgery, to remove the larynx, doing a palliative laryngectomy, rather than removing the cartilage only, which is a formidable procedure, too. I believe better results can be secured by doing a palliative laryngectomy.

On the question of tracheotomy and the advantage of low tracheotomy in order to avoid further complications, I believe that if one removes only a segment of a tracheal ring, rather than doing the conventional tracheotomy and cut two or three rings, it will lessen the chances for necrosis, and also permits one to place the tracheotomy tube at a low point.

Laryngectomy or any surgical procedure following radionecrosis is difficult. In two instances where laryngectomy was done following intensive therapy one had a recurrence of growth plus necrosis; in the other I was unable to demonstrate recurrence until after the larynx had been removed. Now laryngectomy can be done with greater safety because of antibiotics which diminish infection.

Those of us who believe that cancer limited to the larynx is best treated by surgery rather than other methods must compliment Dr. Desjardins and his associates for the excellent results they have secured, for, after all, his group of cases were not considered surgical problems. Knowing New and Figi and the group at the Mayo Clinic, I know their views with regard to surgery, and when they turn over a patient to the radiologist for irradiation, the assumption is that it is not a surgical problem. As he has emphasized, we laryngologists are sympathetic with you, but we consider our five year rates much better than yours if the case is still a surgical problem.

The author well stated that if one contemplates treating only those patients whom one can cure, one will not have many and that is true. One must treat many patients, not with a view to curing them but relieving them of some of their difficulties, and, if possible, prolonging life. That certainly applies to carcinoma of the larynx and one is justified, in the inoperable case, in proceeding with this technique.

There was a time when I considered irradiation as a form of euthanasia, because when intensive irradiation was started, the patient made a very rapid decline and had a wretched time during his remaining days. I wondered whether tracheotomy, plus nerve injection to relieve pain, and tube feeding did not give equally good results. The situation has changed a great deal in recent years and we, too, have some five year cures in patients that we said were not good surgical cases because we did not feel we could remove the carcinoma.

We have also made advances in the field of surgery, so much so that laryngectomy and block dissection of the neck can be carried out; with the antibiotics infection is uncommon and fistulas are rare. We can now contemplate doing laryngectomy and a radical block dissection, provided the metastasis still is confined to the neck. I believe a combination of surgery plus irradiation is probably going to offer more in these cases than either one or the other, and I do further believe that the future of carcinoma of the larynx, particularly in advanced cases, is much more cheerful now than it was a few years ago.

Dr. Douglas Quick, New York, N. Y. I thank you for the privilege of discussing this very excellent and, at the same time, very unusual paper by Dr. Desjardins and his associates. At an earlier period in the half-century, or less, of therapeutic radiology our experiences, reports, and discussions were of necessity limited to advanced cases. As we have progressed, the advanced material has received less and less of our active consideration. In this present instance, we have a most excellent and able presentation on the treatment of the material cast off by the Department of Surgery in an institution recognized internationally as a surgical or surgically minded institution. Not only has this advanced material been cheerfully and ably treated in an individualized manner, but, in reporting it, the authors have given the center of the stage to their surgical confrères by quoting, in detail, the excellent operative statistics from the Surgical Department. The explanation is to be found, I believe, in a paragraph toward the end of the paper, as follows: "To practice medicine means not only to try to cure patients when this is feasible but also to relieve suffering in any form where a cure is impossible." The care of this group of patients has been the work of the physician rather than that of the technician. The distinction between cure and palliation has obviously been kept constantly in mind, as indicated by the varying of dosage factors and time intervals, depending on the reaction of the individual from day to day. Any discussion on this report must, of necessity, be in the nature of expressing approval, emphasizing certain points, or offering possible minor suggestions.

For the purposes of strict clarity, I would rather have referred to this group of cases as cancer of the "larynx and hypopharynx" or "larynx, intrinsic and extrinsic," rather than just "larynx." The larynx group, strictly speaking, embodies a more limited group, anatomically and histopathologically, and a group more favorable, in fact, from the standpoint of roentgen therapy. The results here reported are more difficult of attainment by reason of the vagaries of the diseases and the anatomic areas involved.

In my judgment, carcinoma of the hypopharynx or extrinsic larnyx is never "operable" although it frequently comes to the therapeutic radiologist after it has been operated upon or at.

The number of preliminary tracheotomies reported in this paper attest the advanced character of the disease on admission for treatment. The small number necessitated during treatment indicates the care with which treatment was carried out. It has been my experience that small initial doses, with gradual daily increase, frequently gets by in the border-line case where heavy initial exposures would precipitate the need for tracheotomy. I would like to commend and endorse the suggested maximum daily exposures here advocated. In my experience, the total of daily exposure over 300 r, in air, does more harm than good and precludes an otherwise much higher total dosage tolerance.

I believe the total dosage, here indicated, is about as high as it is safe to go with the factors indicated and with palliation only as a constant consideration. It is my feeling, and with due deference to the physicists, that a somewhat higher total tumor dose can be delivered, in the ultimate, if the skin-target distance is increased well beyond 50 cm. I feel quite sure, clinically, that this is possible in using the smaller fields with earlier and, anatomically, less extensive lesions. With these earlier growths, also, I prefer three fields rather than two. The use of three fields permits of a more practical uniform distribution of the radiation within the limits of everyday technical adjustment.

I have no opinion on a maximum treatment interval—whether it be thirty or sixty days—the response and reaction of the patient from day to day, especially the advanced case, is more important than adherence to technical rote, ending, perhaps, in a casualty.

When lymph nodes are involved, in the cervical area, it has been my experience that, except for the totally undifferentiated growths (Grade 4), radium, by implantation of radon seeds or element needle transfixion, has something definite to offer from the standpoint of palliation or possible "five year cure" as a supplement to roentgen therapy. The nausea attendant upon treatment is a problem of practical importance. All too often, it is due to overdosage in the daily exposure. Routine periodic throat irrigations, to eliminate mucus and the resultant gagging, eliminates some cases. We are all familiar with the value of liver extract and the B-group of vitamins. The intravenous use of pyridoxine is to be commended highly in certain instances where the other measures fail. The postnasal feeding tube is to be commended for both loss of weight and, sometimes, overemphasized nausea.

In the beginning of my discussion, I noted the courtesy shown the Surgical Department in the quoting of their operative results. I hope that that department and similar departments elsewhere take note of the results achieved in the care of those patients who were beyond their reach. In addition to the comfort and palliative aid given to all of them—and this is too often overlooked—a five year survival rate of 17.5 per cent is a truly wonderful achievement. Such results demand, for irradiation, a trial in the less advanced cases; and for the more favorable and earlier cases, they demand at least a consideration of radiation on an equal basis with surgery.

Concerning the other paper by Dr. Lenz and Dr. Goodrich, I will not attempt to take time to enter into that discussion, but I would like to mention one point, and that is that it was very cheering, indeed, to have stressed both in the presentation and in the discussion by Dr. Clerf, the factor of infection as being the activating, aggravating, complicating factor. In the absence of infection, the problems of laryngeal cartilage complications are infinitely less.

DR. LENZ (closing). Dr. Quick's mention of the problem of laryngeal infection permits me to emphasize again that chondronecrosis in the presence of a small cancer was encountered only once in the 28 cases we studied. The extensiveness of the cancer destroying the perichondrium and facilitating the entrance of bacteria, more than the technique of modern radiotherapy, seems to account for laryngeal chondronecrosis after roentgen therapy of laryngeal cancer. It is unfortunate that Dr. Desjardins gets only extensive cases for roentgen therapy. Results of this treatment in small cordal cancers are as good as with laryngofissure and the voice is better. The discrepancy in the estimated distance between the center of the irradiated lateral neck field and the center of the larynx in Dr. Desjardins' and in our reports is due to a difference in the size of the irradiation fields. Dr. Desjardins' larger fields extend farther back and as the larynx is situated in the anterior portion of the neck his average distance between the centers of the irradiation field and larynx is 6 cm.; with our smaller fields this is 3 cm. The tumor dose would then be about equal to the air dose with the usual 200 kv., 0.5 mm. Cu, 50 cm. target skin distance and a circular field of 6 by 8 or 7 cm. With much larger or much smaller fields this would not hold true.

Vol. 60, No. 1

ROENTGEN THERAPY OF MALIGNANT TUMORS OF THE TESTIS*

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WITHIN a short period after roentgen therapy first was used in cases of tumor of the testis, it became obvious to many observers that true malignant teratomas are much less susceptible to the action of roentgen rays than are seminomas. The fact that seminomas are highly radiosensitive was noted by Chevassu in his thesis. The radioresistance of teratomas, on the other hand, was emphasized by Desjardins, Squire and Morton about twenty years ago. They stated that "testicular tumors of the mixed or teratoid group are influenced much less (than seminomas) by roentgen or radium rays. Moreover, their susceptibility is a measure of the degree of epithelial preponderance in the cellular composition of such neoplasms. When cartilaginous, myxomatous, or fibrous tissue is an important feature, the influence of irradiation is slight or nil. True teratomas remain practically unaffected by irradiation."

Seminomas and malignant teratomas together constitute about 95 per cent of all malignant tumors of the testis. Seminomas are encountered about six times more frequently than malignant teratomas. Both of these tumors occur during the years of greatest sexual potency but the maximal incidence of teratomas occurs earlier in life than does the maximal incidence of seminomas.

It was pointed out by Nash, Scheetz and me[5,6,7,8] that, although there are many points on which a differential diagnosis may be postulated, the only certain and absolute method of distinguishing these tumors from each other is by microscopic examination of intact tissue. Nash stated that the histopathologic characteristics of a seminoma are so definite that the tumor can be diagnosed even when sections of metastatic deposits in any part of the body are examined microscopically.

The microscopic appearance of a malignant teratoma, on the other hand, is entirely different and is characterized by the varied appearance of different portions of the tumor. In general, the tumor consists of embryonal structures arranged in such confusion as to eliminate any resemblance to an embryo. Usually, if enough sections are studied, one may identify tissues derived from all three germ layers, but by far the greatest incidence of neoplastic change is in tissues derived from the hypoblastic layer.

McDonald has tersely summarized the difference in the microscopic appearance of these tumors in the following statement: "Seminomas show monotonous uniformity of structure and cellular composition; teratomas, an endless variety."

The difficulties of classifying tumors of the testis were pointed out by Nash and by Scheetz, both of whom called attention to the complexity of terminology in the literature, which has confused rather than clarified the conception of testicular tumors. Both of these authors have adopted the classification of Broders, because it seemed to them to be inclusive, simple and useful. Whether these tumors originate from the same source or from different sources is not particularly important as far as the usefulness of this classification is concerned. They stated that it is sufficiently inclusive to embrace all common varieties of malignant epithelial tumors of the testis; further subdivision would seem to be super-

* Presented at the Twenty-ninth Annual Meeting, American Radium Society, Atlantic City, N. J., June 9–10, 1947.

fluous, unnecessary and in most cases impossible.

Broders has divided tumors of the seminal epithelium into three main groups: (1) teratomas, (2) adenocarcinomas of the seminoma type, and (3) adenocarcinoma of the testis. The teratomas were subdivided into two groups: (1) benign teratomas, and (2) malignant teratomas.

The adoption of Broders' classification, it seems to me, would go a long way toward correcting the confusing and contradictory views about testicular tumors.

I regard the report of the microscopic examination of intact testicular tissue as of fundamental importance in planning roentgen therapy for a patient with a tumor of the testis, because there are, on the one hand, the seminoma which is radiosensitive and has a relatively good prognosis, and, on the other hand, the malignant teratoma which is usually resistant and has a poor prognosis. A distinction by the pathologist of seminoma from malignant teratoma, therefore, gives the basic indications on which roentgen therapy may be planned.

Since there is no way by which the extremely important diagnostic, therapeutic and prognostic questions can be settled with finality other than by histologic examination of tissue obtained from the testis, it follows as a corollary that the tissue should be intact, should not be altered by extraneous influences and should be truly representative of the structure of the tumor in question. It is the opinion of physicians at the Clinic who have treated patients with these types of tumors that suitable tissue is best obtained by simple orchectomy without preoperative irradiation.

Simple orchectomy, in addition to providing information that is of value from a diagnostic and prognostic standpoint, eliminates infection and discomfort in cases of a large scrotal tumor. In addition, it removes a focus from which metastasis may take place. Because a diagnosis of the presence or type of testicular tumor cannot always be made after the histopathologic appearance of the tumor has been changed by irradiation (a fact that was emphasized by Nash), orchectomy is advised both as a diagnostic and therapeutic procedure even in the presence of known metastatic lesions in all but very exceptional cases. As far as can be determined from the literature, most American surgeons prefer simple orchectomy to a more radical operation.

After a brief period of postoperative convalescence (usually a few days) it is our practice at the Mayo Clinic to administer a course of postoperative radiotherapy. Recently malignant teratomas have been exempted. For this course of treatment, radium was used in the early days, but because roentgen therapy is, as a rule, more practical, more efficient, and more expedient than radium therapy, radium is now seldom used except for the occasional treatment of a small metastatic lesion in the supraclavicular region or, possibly, for a small localized recurrent lesion in the scrotum. This procedure is in accordance with the general practice of most radiologists.

In postoperative treatment many roentgenologists apply the roentgen rays only to an inguinal field or to one or more abdominal fields and do not irradiate above the diaphragm unless there is definite evidence that metastasis has occurred at this site. Some authors have stated that they routinely irradiate the abdomen through one or two large anterior or posterior fields; the rays are generated at 200 kv. and the dose is in excess of 500 r. A few have stated that they irradiate the thorax. Treatment of the supraclavicular space seldom is mentioned as a prophylactic postoperative procedure. Lumbar and sacral fields are commonly irradiated in the treatment of teratomas but they are seldom treated in cases of seminoma. It must be admitted in fairness, however, that in evaluating techniques of irradiation one must be wary of the term "teratoma" because it is often used erroneously, I think, as a generic term for all testicular tumors, whereas it should be used to designate a specific testicular neoplasm. As has been indicated previously, many radiologists prefer to use roentgen rays

generated in the neighborhood of 200 kv. and heavily filtered. Some authors believe that roentgen rays in the "supervoltage" range have superior qualities. Just as the number of fields treated varies widely, the dose for each field varies from 500 r to 4,000 r.

For a long time it has been the view of the members of the Section on Therapeutic Radiology of the Mayo Clinic that the techniques of palliative and curative treatment should often be different; that a radiosensitive and a radioresistant tumor should not necessarily be treated in the same way; that an old or debilitated patient should receive milder treatment than a young or vigorous one; that clinical, physiologic and pathologic data are of equal or even of greater importance than are most physical factors in outlining the treatment for a patient; that the patient should not be killed by a lethal dose of roentgen rays in order to obliterate the tumor; that the quantitative aspects of dosage often are less important than the method by which treatment is given; that injury of the skin is generally of less importance than severe injury of the formed elements of the blood or permanent injury of a viscus adjacent to the tumor; that injuries to the patient are in general directly proportional to the magnitude of the radiation that is absorbed; that in comparable doses high voltage roentgen rays are more injurious to deep-lying structures than are moderate voltage roentgen rays; that a technique suitable for carcinoma of the pharynx cannot be applied without much modification and reservation to the treatment of sensitive tumors in the abdomen, because of the different geometric and physiologic considerations involved; that the application of gamma rays (or roentgen rays approaching the wavelength of gamma rays) as such confers no immunity on either the skin or on normal structures and does not increase the radiosensitivity of any tumor; that the best clinical indication of the magnitude of the volume or the tissue dose is the leukocyte count, and finally, that precise radiotherapy is subject to all the variations, confusions and disappointments of other methods of treatment used in all other clinical fields, because the living world knows no constants. For a long time we have regarded these truths as self-evident; they are the basis of our ideas about radiotherapy but it must be admitted that they are at variance with those of many radiologists.

It is my present opinion that irradiation of seminomas of the testis and their secondary deposits is best carried out as a rule with roentgen rays of moderate voltage (130 to 140 kv.). This opinion is based on a rather large experience. This type of treatment is used because I know of no proof of the superiority of higher voltage roentgen rays, particularly rays generated at 200 kv. or more. Sometimes, in fact, I have seen patients with metastatic lesions in the abdomen who have not responded well to large doses of high voltage roentgen rays that have been administered elsewhere and I have observed that the application of moderate doses of rays generated at 130 kv. caused the lesions to disappear. Furthermore, prophylactic postoperative treatment, if it is to be truly protective against metastasis, should be applied to *all* lymphatic pathways through which metastasis may take place. This, obviously, makes extensive treatment necessary. The risk of such treatment is greater with rays generated at higher voltages, because the irradiation of the fields which usually should be irradiated as a prophylactic measure produces more reaction and more destruction of leukocytes and increases the risk of injuring normal viscera. I do not feel that a patient should be subjected to the risk of injury from roentgen treatment unless there is some valid indication for such an injury, and to my mind prophylaxis should not necessitate injury.

At the Clinic we routinely irradiate four anterior abdominal fields extending from the xiphoid cartilage to the pubic region (two each side of the midline)* and four

* These are omitted if we are quite certain that there are no metastatic lesions in the abdomen.

corresponding posterior fields. The mediastinum and the left supraclavicular space also are always treated. Each field receives a total dose of about 540 r (in air). One or two fields are treated daily, depending, of course, on the patient's tolerance and especially on the leukocyte count. This course of treatment is repeated in a month. If metastatic lesions have been present in the abdomen before operation, a third course is given after a lapse of two months.

For seminomas of the testis, the doses used at the Clinic are low in comparison with those used elsewhere; we feel that the use of rays generated at high voltage or more intense treatment generally is not indicated for seminomas—the high radiosensitivity of which has been universally recognized—since not only are the published results of more intense treatment used elsewhere no better than our results but the technique usually entails more risk to the patient. Incidentally, in the treatment of at least 500 testicular tumors in a period of twenty years, we have never had a death which could be attributed in any way to roentgen therapy. That our methods of treatment have proved satisfactory is confirmed by the statistical study which Cabot and Berkson made of the results of treatment of these lesions. They found that in all cases of seminoma of the testis the five year survival rate was 67.7 per cent, whereas in cases of all other malignant tumors of the testis the five year survival rate was 29.3 per cent. Of all patients who had seminomas and who received roentgen therapy, 71 per cent lived five years or more. In the cases in which roentgen therapy was not employed, the five year survival rate was 58.8 per cent. In general, in cases in which there is no evidence of abdominal metastasis at the time of irradiation, the three year survival rate is twice as high as it is in cases in which metastatic lesions are present in the abdomen. Two-thirds of the patients who do not have metastatic lesions in the abdomen live at least three years. The presence or absence of metastatic lesions in the abdomen obviously is of the greatest importance both from the viewpoint of roentgenologic technique and of prognosis.

The symptoms of metastatic involvement of the para-aortic lymph nodes have been ably described by Desjardins and their importance has been pointed out by Nash and by Scheetz.

Involvement of these nodes by metastatic deposits from testicular tumors probably takes place earlier in cases of malignant teratoma than it does in cases of seminoma. Involvement of those nodes frequently produces a dull aching pain in the back which is often called "lumbago" by the patient. The pain may extend into the hip or leg and is often attributed to sciatica. Bloating, belching, fullness in the abdomen after meals, and constipation commonly occur after the para-aortic nodes have become involved. When the epigastric nodes are the site of secondary deposits, symptoms referable to the abdominal viscera may occur so suddenly as to simulate an acute disease of the abdomen. Desjardins has pointed out that, although it is sometimes difficult to be certain of metastatic involvement of the para-aortic lymph nodes in many cases, a diagnosis can be made on the basis of the history and the physical findings. When a definite mass cannot be palpated, only deep abdominal resistance may be found and pressure by the examiner's hand at the site of this vague resistance elicits tenderness which is not found when similar pressure is made on a normal abdomen. When the metastatic lesion in the abdomen has become sufficiently large it may be palpated easily as a smooth or irregular firm, immobile mass, lying most often on the side of the abdomen corresponding to the diseased testis or toward the midline in the epigastric region. In certain cases, special techniques of roentgenography or urography may give definite indications of metastatic involvement of the para-aortic lymph nodes.

In the presence of any of these signs or symptoms, the best practice is to institute treatment for a metastatic lesion; even if

the evidence regarding the presence of such a lesion is vague or inconclusive it is advisable to institute treatment.

Metastatic involvement of one or more of the left supraclavicular lymph nodes is the forerunner of involvement of the peribronchial nodes and is usually secondary to involvement of the lymph nodes in the upper part of the abdomen. The enlargement of left supraclavicular nodes of a man is an urgent indication for examination of the testes. In cases of malignant teratoma, involvement of the supraclavicular nodes occurs more often and earlier in the course of the disease than it does in cases of seminoma.

Enlargement of the inguinal lymph nodes is not definite evidence of involvement by metastatic deposits from testicular tumors. Such metastasis is evidence that the tumor of the testis has perforated its capsule and has spread to trunks draining into the groins. The diagnosis of metastatic involvement of the inguinal nodes, therefore, should be supported by definite evidence that the tumor actually has involved the capsule and also by biopsy of an enlarged lymph node.

Since it is well known that seminoma of the testis responds well to roentgen therapy the therapeutic test can often be used with high accuracy to judge the nature of metastatic lesions when their histopathologic structure is unknown. Some tumors may be a mixture of a seminoma and a teratoma. In this case, the initial response of the tumor may be satisfactory because the seminoma is destroyed; however, after the initial response has taken place, the residual tumor, which is made up of more resistant cells, may not respond and the tumor may grow in spite of treatment.

For the treatment of seminomas, roentgen therapy has assumed a position of prime importance and has altered the prognosis from one of hopelessness to one of subdued optimism.

This is quite different from the prognosis of malignant teratoma of the testis. The study by Scheetz showed that the experience of roentgenologists in the past few years and the results that they have reported confirm the remarks which Desjardins, Squire and Morton made twenty years ago about the lack of response of these tumors.

It might be stated in brief that no technique of treatment which we have used within the limits of safety has been more than temporarily effective in the treatment of metastatic lesions caused by malignant teratomas.

Scheetz, who reviewed 54 cases of proved malignant teratoma, concluded that the only manner in which a cure may be obtained in cases of malignant teratoma of the testis is by performing orchectomy before metastasis has occurred. He said that this objective can be attained in less than a third of all cases. He did not think that roentgen therapy appeared to have any beneficial effect on malignant teratoma of the testis, which is extremely resistant to roentgen rays. After metastasis, death usually occurred within eighteen months. Ironically enough, in the case in which the patient survived for the longest time, that is for twenty-four years, postoperatively, radiotherapy was not employed. Scheetz felt that the patients who lived for an appreciable period after operation were fortunate enough to have undergone orchectomy when the teratoma still was confined to the testis. In the cases in which the patients had died, it seemed likely that metastasis had occurred before operation was performed but that the metastatic lesions had not been large enough to produce clinical signs or symptoms at the time when the patients first were examined at the Clinic.

Since the radiosensitivity and, therefore, the prognosis of seminomas are completely different from the radiosensitivity and prognosis of malignant teratomas, we feel that our insistence on accurate pathologic diagnosis as a basis for roentgen treatment is justified. Because the method of treatment we use is as effective as any reported, is safer than many types of treatment and

is based on extensive experience, we can see no sensible reason for changing it.

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Vol. 60, No. 1

PRELIMINARY REPORT ON THE CLINICAL USE OF RADIOACTIVE IODINE (I^{131})*

By EARL R. MILLER, M.D., MAYO H. SOLEY, M.D., *and* MORRIS E. DAILEY, M.D.

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RADIO-IODINE is the element iodine made capable of spontaneously disintegrating and emitting radiation, either beta particles, or beta particles and gamma rays. It is useful in therapy since this radiation may destroy the cells which absorb the iodine, and useful in tracer work since it allows one to follow the fate and metabolism of the iodine by observing the radiations emitted from it. There is no difference in the metabolism of radioactive and of non-radioactive iodine. However there are eleven different radioactive isotopes of iodine which differ enough in radiation action on the thyroid even with the same number of millicuries absorbed, that they might well be considered as different substances. This is true because the different isotopes have marked differences in their half-lives and their radiations have markedly different energies.

This is well reflected in the case of I^{130} and I^{131}, both of which have beta and gamma radiation. The energy of the radiation from the I^{130} is much greater than that from I^{131}. The half-life of the I^{130} is 12.6 hours and that of I^{131} is eight days. Therefore, the I^{130} will act with great effect over a short time and the I^{131} will act with less effect per unit time, but will act over a very long time. This difference will make a great difference in the dose administered to accomplish the same end. This difference may be as much as fifty times.

Radio-iodine is useful in the treatment of Graves' disease in which the thyroid is not saturated with iodine. It is not useful in the therapy of Graves' disease in which the thyroid is saturated with iodine, nor is it useful in the treatment of thyroiditis, nontoxic goiter, or involutionary nodules in the thyroid. It is occasionally useful in therapy of carcinoma. In the first condition the thyroid can and does take up and hold tenaciously a great deal of the iodine, is subjected to the radiation from it and the radiation will control the disease. In the other conditions the abnormal tissue in the thyroid will not take up the iodine and therefore cannot be subjected to the radiation from it, even though radiation may be effective in controlling the disease.

This study was made in order to determine if possible the uptake of radio-iodine in microcuries in the human thyroid in situ after oral administration of I^{131}. From this, an estimate of the energy dissipated within the thyroid can be made. If the weight of the thyroid can be determined and one is willing to assume that the distribution of the iodine, and therefore the radiation, in the gland is uniform, then the dose can be converted to roentgens as outlined by R. D. Evans.[1] This has the merit of giving the dose in terms comparable with those used in already established roentgen therapy and in terms with which the radiologist is already familiar.

But it is known that the distribution of radio-iodine in the thyroid is not uniform and the estimation of the weight of the gland is subject to error even in well trained hands. It would seem therefore, that it would be better to describe the dose in microcuries of I^{131}, in the thyroid, rather than to attempt to give it in roentgens. Our curves show that an estimate of thyroid weight is necessary to arrive at an accurate estimate of the amount of I^{131} in the thyroid, but an error in estimation of the weight of the thyroid will introduce a rel-

* From the Divisions of Radiology and Medicine of the University of California Medical School and Hospital, San Francisco, California. Presented at the Forty-seventh Annual Meeting, American Roentgen Ray Society, Cincinnati, Ohio, Sept. 17–20, 1946.

atively small error in the estimate of the uptake in microcuries of I^{131}, if proper conditions for measurement are chosen.

The iodine solution is calibrated in microcuries per cubic centimeter. This is done

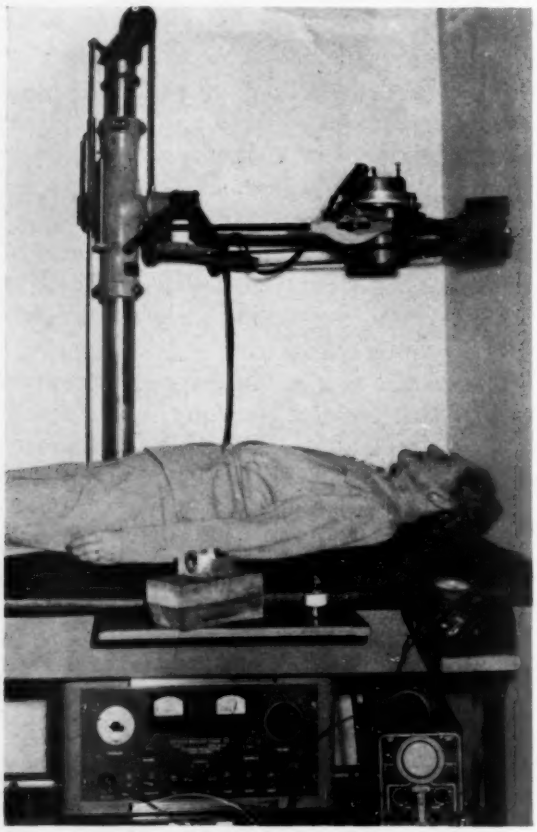

FIG. 1. Apparatus for measuring the amount of I^{131} in the thyroid. Directly above the patient's neck is a lead cylinder containing the Geiger-Müller tube. On the shelf at the side of the patient, stands a 60 cc. standard serum bottle containing the known amount of radio-iodine. To its left, also on the shelf is shown a similar bottle lying on a wooden phantom which resembles the neck in size, in order to equalize back-scatter from the specimen and from the neck. To the right, on the small shelf are the register and timer for the scaling circuits; below to the left is the scaler for the Geiger counter and to the right below is the oscilloscope.

by taking 1 cc. of the stock solution, diluting to 100 cc. with water, drying 1 cc. of this on a porcelain dish and determining its beta activity by means of a calibrated thin aluminum windowed Lauritsen electroscope. The measured millicuries were the same in Oak Ridge as in California.

The dose of the solution in cubic centimeters is determined by dividing the dose to be given in microcuries by the number of microcuries per cubic centimeter. The iodine solution is put into about 50 cc. of water and the patient drinks the entire solution. The glass is then washed in about another 50 cc. of water. This is given to the patient who washes his mouth with and drinks this water. This is repeated once.

The iodine is administered in the evening and measurements are made on the patients during the following two days during the daytime. Follow-up measurements are made at one and two week intervals. The patients are re-evaluated clinically and with laboratory tests at the end of a month to determine their status and possible need for more treatment.

The Geiger counter is used vertically (Fig. 1). It is encased in a lead cylinder with 1 inch walls. The front surface of the lead cylinder is covered by 1 mm. of lead filter. The front surface of the Geiger counter is 7 cm. behind the lead filter. The sample of radio-iodine or the patient's thyroid, is placed at a known distance (22 to 46 cm.) from the front of the cylinder, making the front of the counter 29 to 53 cm. from the specimen. The front opening in the cylinder is 2 inches in diameter. The area that the tube "sees" is a circle varying in diameter with the distance, up to 14 inches.

The long distance between the sample and counter used in these measurements was chosen so that the error due to the depth of the thyroid in the neck and the error due to the depth in the thyroid from which the gamma ray originated would be minimized. Also it was thought that the effect on the counts due to the change in the size of the thyroid or sample would be less at the large distance than at a lesser one.

The lead filter was used so that only the harder components of the radiation from

the thyroid would be recorded. This reduces the error due to self absorption of the radiation in the thyroid or in the sample.

Before any measurements are made, a background reading of the instrument is determined. The patient is then placed

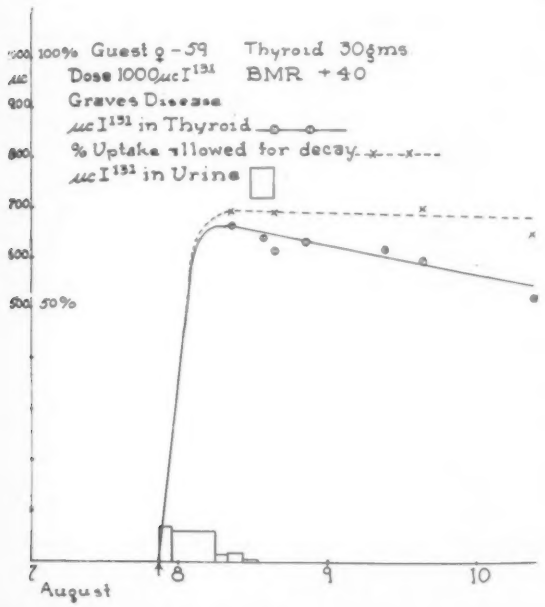

Fig. 2. Curve of uptake of I^{131} in the thyroid of a patient with Graves' disease. The solid line shows the number of microcuries of I^{131} in the thyroid after the administration of a dose of 1,000 microcuries of iodine, given on August 7, 1946, in the evening as shown by the arrow. The dotted line curve shows how much of this iodine would have been in the thyroid if there had been no decay of the iodine. Note how flat this curve is. If the dotted curve were horizontal it would mean that no radio-iodine left the thyroid once it had been deposited there. The bar graph along the abscissa shows the amount of I^{131} in specimens of urine collected as shown in time.

supine on a table, so that the isthmus of the thyroid is directly under the center of the counter. The reading is taken in this position. The counter is then moved over the thigh just above the knee, using the same distance from counter to skin and the count is again taken. This area was chosen because it will be noted that the diameter of the thigh just above the knee is about the same as that of the neck. This should allow

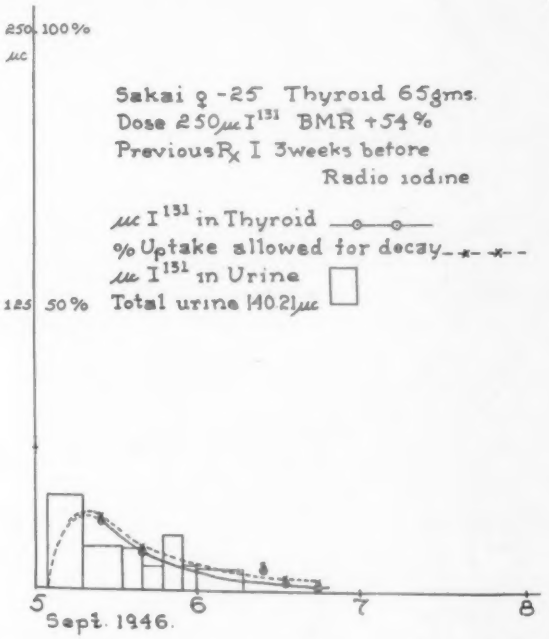

Fig. 3. Shows the uptake of I^{131} in the thyroid of a patient with Graves' disease who had been treated recently with inert iodine. Note the very small uptake of radio-iodine in this case as compared with the case of the untreated Graves' disease.

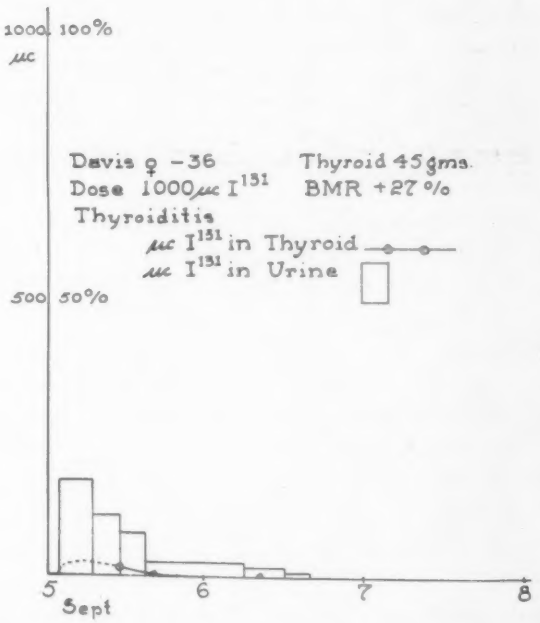

Fig. 4. This shows the uptake of I^{131} in a patient with thyroiditis. Note that the uptake here is so small as to be hardly measurable.

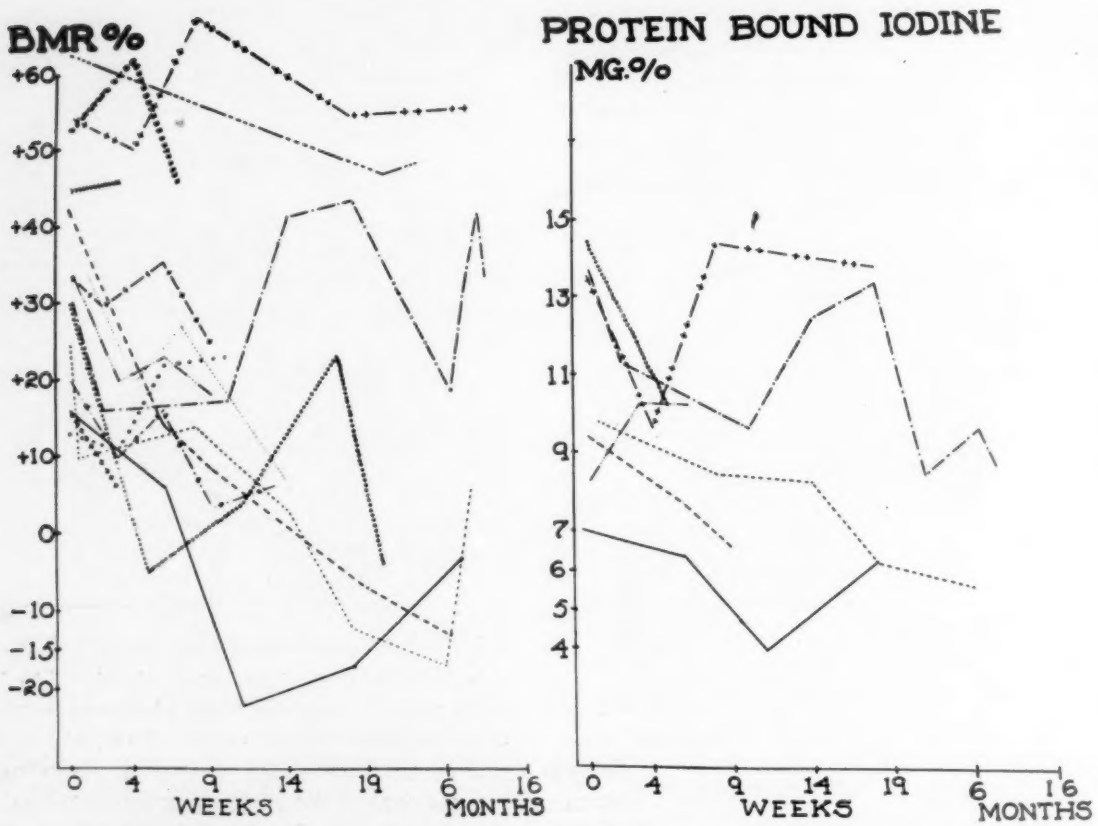

FIG. 5. These are composite curves of the results on the basal metabolic rate and protein-bound iodine of patients with Graves' disease treated with small doses of I^{131}. It will be observed that in general the basal metabolic rates fall at first and then rise. This is because the doses were too small. Also, note that in patients with extremely high basal metabolic rates the small doses of iodine were almost entirely ineffective. The curve of the protein-bound iodine reflects similar effects.

us to subtract the reading taken over the thigh from the reading taken over the neck and thyroid and leave the reading due only to the thyroid. The distance usually chosen is 22 cm. if the dose is about 250 microcuries, and 46 cm. if the dose is 1 millicurie.

A 60 cc. cylindrical bottle, filled with an aqueous solution of radioactive iodine of known potency, is then placed in front of the counter at the same distance. The reading from this is taken. This bottle is approximately the same size as the thyroid and is about as deep as the thyroid is in the neck. The number of counts per minute per microcurie in the iodine solution is determined. This is used as a standard for determining the number of microcuries of radio-iodine in the thyroid.

A sample calculation follows:

Patient: C.J. Date: 8-8-46	Time: 4:45 P.M.
Counts over neck (46 cm.)	454 C×8/min.
Counts over thigh (46 cm.)	32 C×8/min.
Therefore, counts due to thyroid	422 C×8/min.
Iodine standard (146 microcuries, 46 cm.)	104 C×8/min.
Background	16 C×8/min.
Counts due to 146 microcuries	88 C×8/min.

Therefore, $\frac{88}{146} = 0.602 =$ number of C×8/min. due to 1 microcurie

$$\frac{\text{Number of C×8/min. due to thyroid}}{\text{Number of C×8/min. due to 1 microcurie}} = \frac{422}{0.602} = 701 \text{ microcuries } I^{131} \text{ in the thyroid.}$$

If this patient had been given 1,000 microcuries of radio-iodine, at the time of measurement, he would have had 701/1,000 or 70.1 per cent retention in the gland. This type of calculation tells one what the gland contains at any given time and the results can be plotted as a function of time.

One can also plot the results, taking into account the decay of the iodine. In this case, one would plot the results as a percentage of the dose taken up and retained by the gland as a function of time. This type of curve shows to better advantage how tightly the thyroid retains the iodine it selects from the blood stream (Fig. 2, 3, and 4).

The results of treatment with small doses of I^{131} are shown in Figure 5.

Doses of I^{131} in these patients varied from 800 microcuries in a single dose to 250 microcuries per week for six weeks. The curves show that the basal metabolic rate and protein-bound iodine return toward normal after administration of radio-iodine, but it is obvious that the doses are too small. This was predicted before this series of patients was treated, but adequate supplies of iodine were not available and

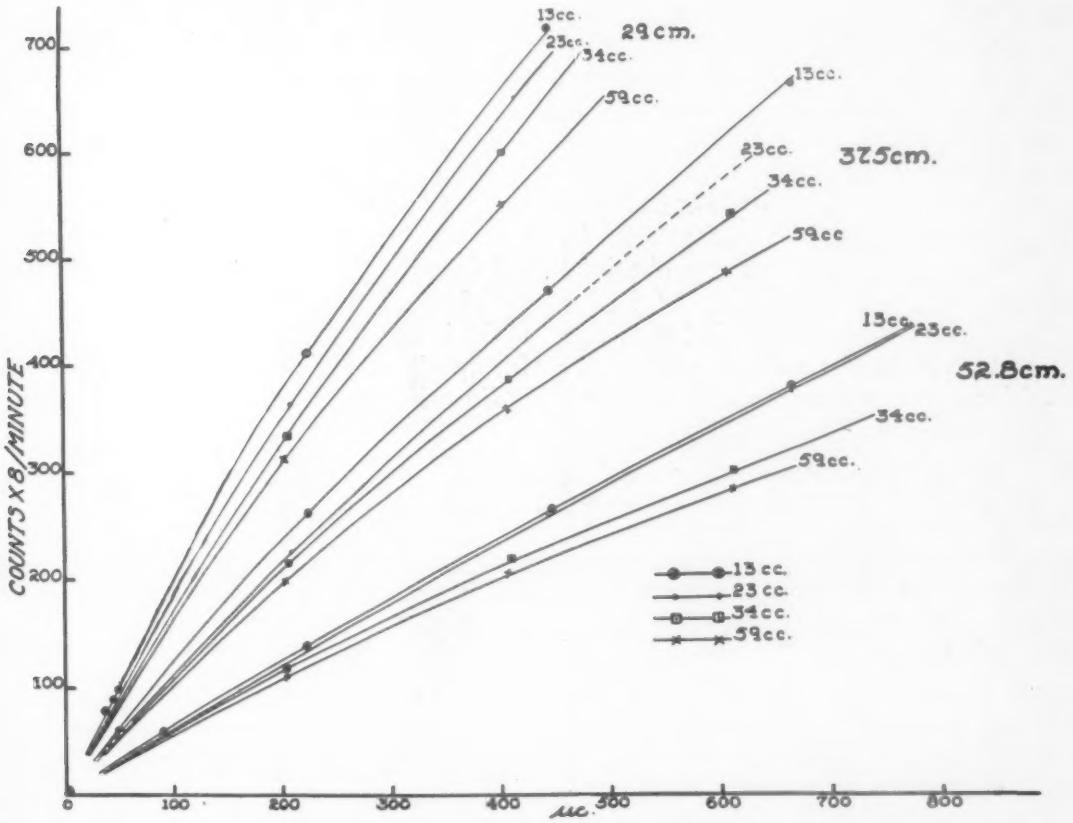

Fig. 6. These are curves obtained by using various amounts of stock solution of radio-iodine and measuring different size containers at different distances in order to determine whether the response of the counters was linear, to study coincidence counts and to study the geometry of the counting. It will be noted that all of the lines are curved so that the number of counts per microcurie varies with the size of the bottle and the distance at which it is measured. If each of these curves were a straight line through the origin then the number of counts per microcurie would be independent of the size of the bottle or thyroid. Since these are not straight lines through the origin, the number of counts per microcurie varies with the size of the specimen and number of microcuries in the specimen. Therefore, it will be necessary in the future to do calibration curves such as these for each new stock solution.

we felt it would be wise to proceed cautiously until methods of measurement were more sure.

As these studies proceeded it was noted that a sample of iodine used as a standard gave a systematically larger number of counts per microcurie as it decayed. It was thought at first that the sample might be a mixture of isotopes or that the beta-gamma ratio of the sample changed with time. There was no change in the geometry of the system during these measurements. Because of this finding the curves shown in Figure 6 were obtained, showing counts times eight per minute plotted against microcuries of I^{131} in the sample at different distances and using different size standards.

The points on these curves were obtained with the same stock solution of iodine and were done within a period of three days, so that radioactive decay plays little part. (The curves are corrected for decay.)

The response of the counter is supposed to be linear up to 20,000 counts per minute, yet these curves show that when samples are actually measured, it appears that the response is not linear. A change in the geometry of the system is, of course, inherent in these measurements, since different size bottles are used, but this change is so small at the greater distances that one would not expect it to be of very great importance. Also there is less change as a function of distance than would be expected if the geometry were of great importance. As a consequence of this finding, the curves of uptake of I^{131} in the thyroids of the patients shown are somewhat in error. Time did not permit their correction. The actual amount taken up in each thyroid is a few per cent greater than those shown. The error will be greater in the patients with large thyroids than in those with small glands and it will be greater with small uptakes than with large uptakes.

A word of caution should be said here about handling radioactive materials. All radioactive materials are dangerous. The alpha emitters may be accidentally inhaled or absorbed through abrasions. Many of these have long half-lives and are deposited in vital structures where they may be lodged for a long time. The beta emitters are more likely to prove dangerous from local effects on hands, whereas the gamma emitters have the same general effect as roentgen rays. Radiologists, because of their training and understanding of radiations and their effects, are going to be called upon to play an important part in the medical future of radioactive materials. Proper care in the handling of these materials will make it unnecessary to write a book in the future about the martyrs to the science of radioactivity.

We wish to thank Doctor J. G. Hamilton of the Radiation Laboratory in Berkeley, California, for supplying the radio-iodine.

We understand that the iodine^{131} was supplied to the Radiation Laboratory by the Clinton Laboratories to partly compensate for the use of the Berkeley cyclotron on Manhattan Project work. Our thanks go also, therefore, to the Clinton Laboratories and to the Manhattan District.

Clinical work on the patients treated with radio-iodine was done by members of the Thyroid Clinic at the University of California.

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San Francisco 22, Calif.

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ROENTGENOGRAPHIC STUDIES OF METHYL METHACRYLATE (LUCITE) PLOMBAGE IN EXTRAPLEURAL PNEUMOLYSIS*

By HERBERT D. KERMAN, M.D.†
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FIFTY-SIX years ago the first report of an extrapleural stripping procedure for pulmonary collapse was introduced into the field of thoracic surgery by Tuffier.[2] Since then many reports of extrapleural pneumolysis have appeared in the literature utilizing a variety of materials to maintain the collapse including: oil, paraffin, air, muscle, fat, surgical gauze, rubber sheeting, and even a rubber balloon. All of these materials for various reasons proved unsuitable. Recently, Wilson and Baker,[3] recognizing the need for a relatively simple

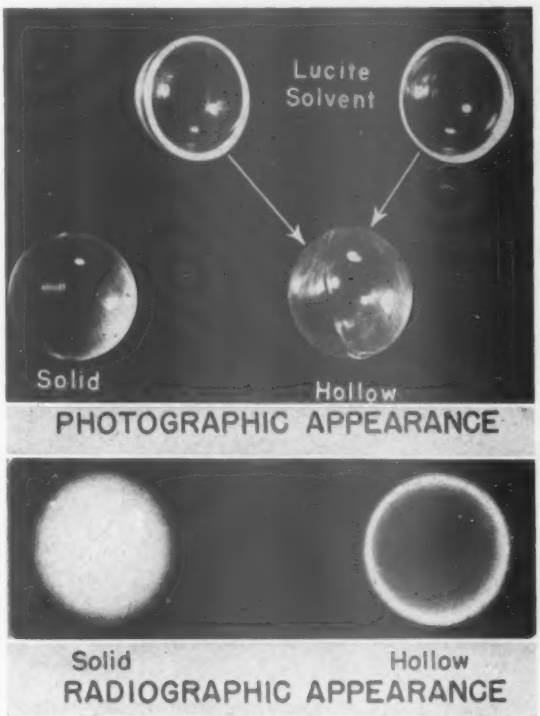
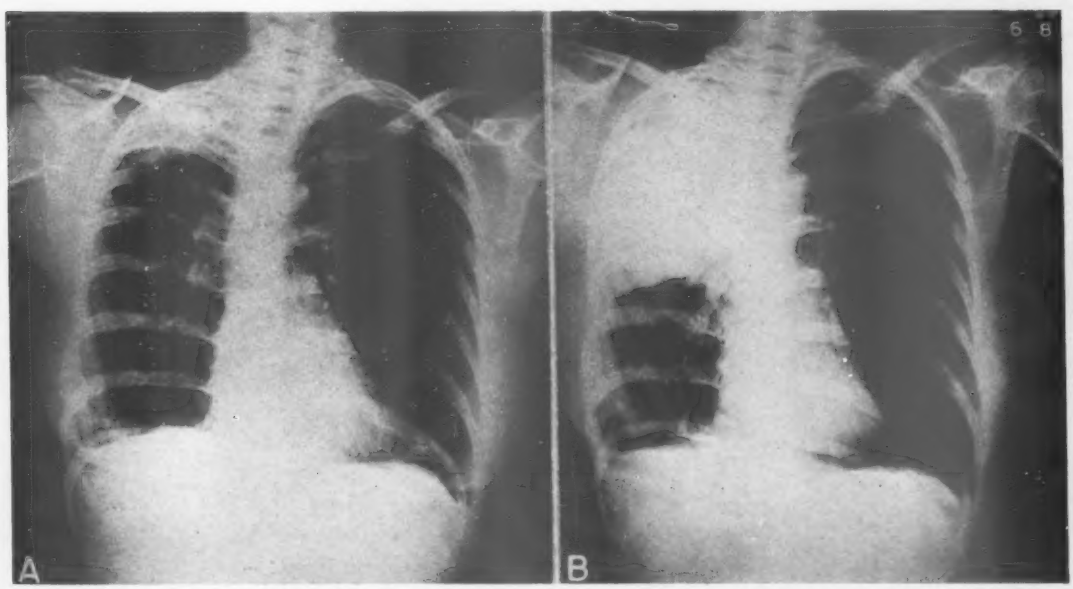


FIG. 1. Photographic and roentgenographic appearance of the methyl methacrylate (lucite) spheres.

FIG. 2. (below) Roentgenograms taken (*A*) before and (*B*) after solid lucite sphere procedures.



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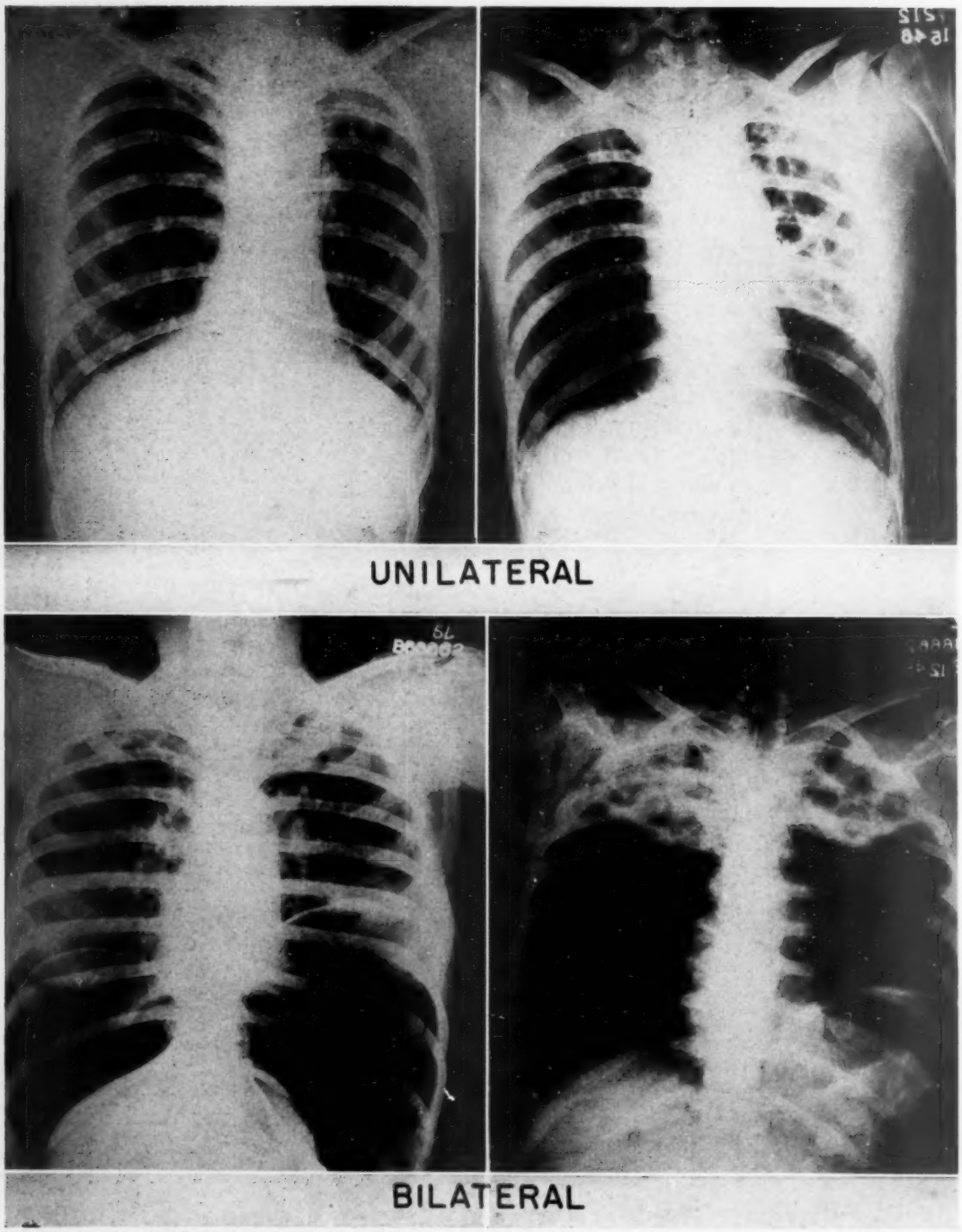

Fig. 3. Roentgenograms before and after (top) unilateral and (bottom) bilateral extrapleural apicolysis and hollow lucite sphere plombage.

procedure which could be used in the treatment of pulmonary tuberculosis in poor risk and complicated cases, found that methyl methacrylate, commonly known as "lucite," was a material that appeared suitable in experimental studies for the maintenance of pulmonary collapse in extrapleural pneumolysis procedures.

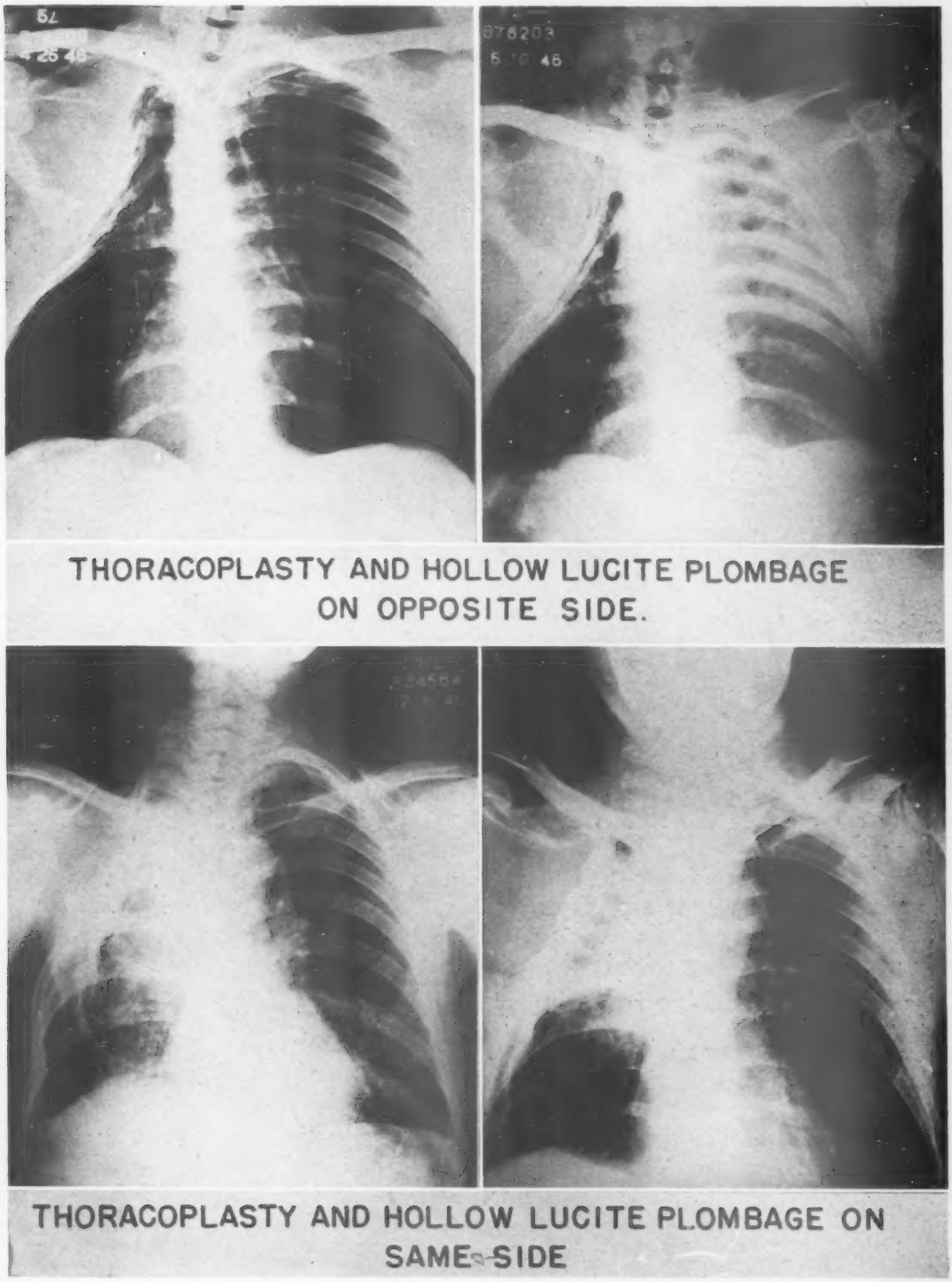

Fig. 4. Roentgenograms before and after (top) thoracoplasty and hollow lucite plombage on opposite sides, and (bottom) thoracoplasty and hollow lucite plombage on same side.

The extrapleural pneumolysis procedure utilizing lucite spheres as packing material has been in use in this clinic in conjunction with the various state tuberculosis sana-

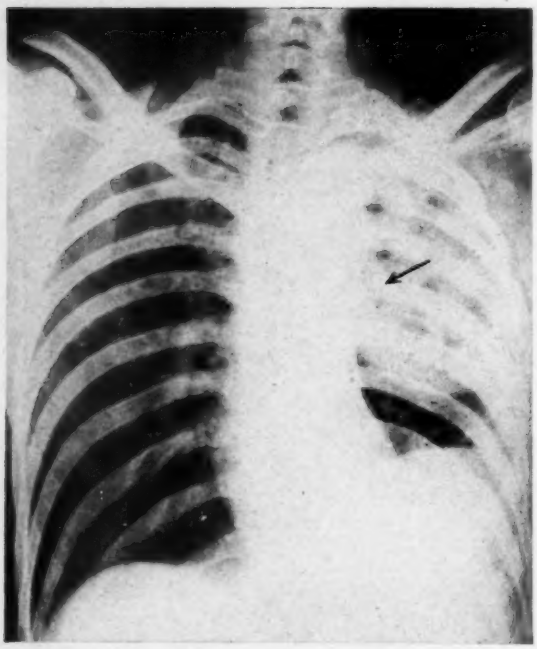

Fig. 5. Cavity visualized on plain roentgenogram following lucite sphere plombage. Note elliptical contour of cavity and spherical appearance of lucite balls.

toria for the surgical treatment of pulmonary tuberculosis during the past nineteen months. McCain and McCain[1] have recently summarized the results obtained in 31 patients.

It is the purpose of this paper to present only the roentgenographic aspects of this procedure, and to emphasize the use of body section roentgenography in the subsequent studies following the lucite plombage.

The lucite spheres are of two varieties. At first, solid spheres were used in the procedure, but these have since been discarded because of weight. Hollow spheres, made by utilizing a lucite solvent to cement two half spheres, have been found to be more satisfactory, and are now used. The solid spheres have a density approximating tissue or fluid, and cast a dense shadow on the roentgenogram. The hollow spheres containing air cast a distinctive ring-like shadow, and this is easily recognized on the roentgenogram (Fig. 1).

In cases in which the solid spheres were used, the roentgenograms revealed an almost homogeneous density caused by the accumulation of a small amount of fluid and fibrous adhesions about the spheres as shown in Figure 2.

The procedure has been used both unilaterally and bilaterally. In Figure 3 examples of each are seen in which hollow spheres were used. The distinctive ring-like shadows of the hollow spheres are, of course, superimposed upon each other, but the characteristic pattern is readily recognized.

Extrapleural apicolysis and lucite plombage has been performed in conjunction and in combination with the usual thoracoplasty as is shown in Figure 4.

In all cases complete collapse and obliteration of the cavities has not been obtained. The procedure will displace and compress the original cavity so that its exact size and location may be obscure in subsequent study of the case. The confusing appearance of the ring-like shadows of the hollow spheres simulating multiple cavities add to the problem of roentgenographic interpretation, but the use of body section roentgenography in the subsequent studies of these cases has been of inestimable value. Occasionally a plain roentgenogram will reveal a cavity in which the size and shape of the cavity is entirely unlike that of the hollow lucite spheres (Fig. 5), but usually planigrams are necessary to demonstrate the residual cavity (Fig. 6).

An interesting series of roentgenograms is shown in Figure 7. In this case a lucite sphere plombage was done. Following the procedure the patient improved symptomatically, but the sputum remained positive. Planigraphic study revealed the cavity as shown in Figure 7*C*, and roentgenograms following subsequent insertion of more lucite spheres reveal the cavity to be obliterated.

DISCUSSION

Extrapleural pneumolysis is a relatively simple procedure which can be used in the surgical treatment of pulmonary tuber-

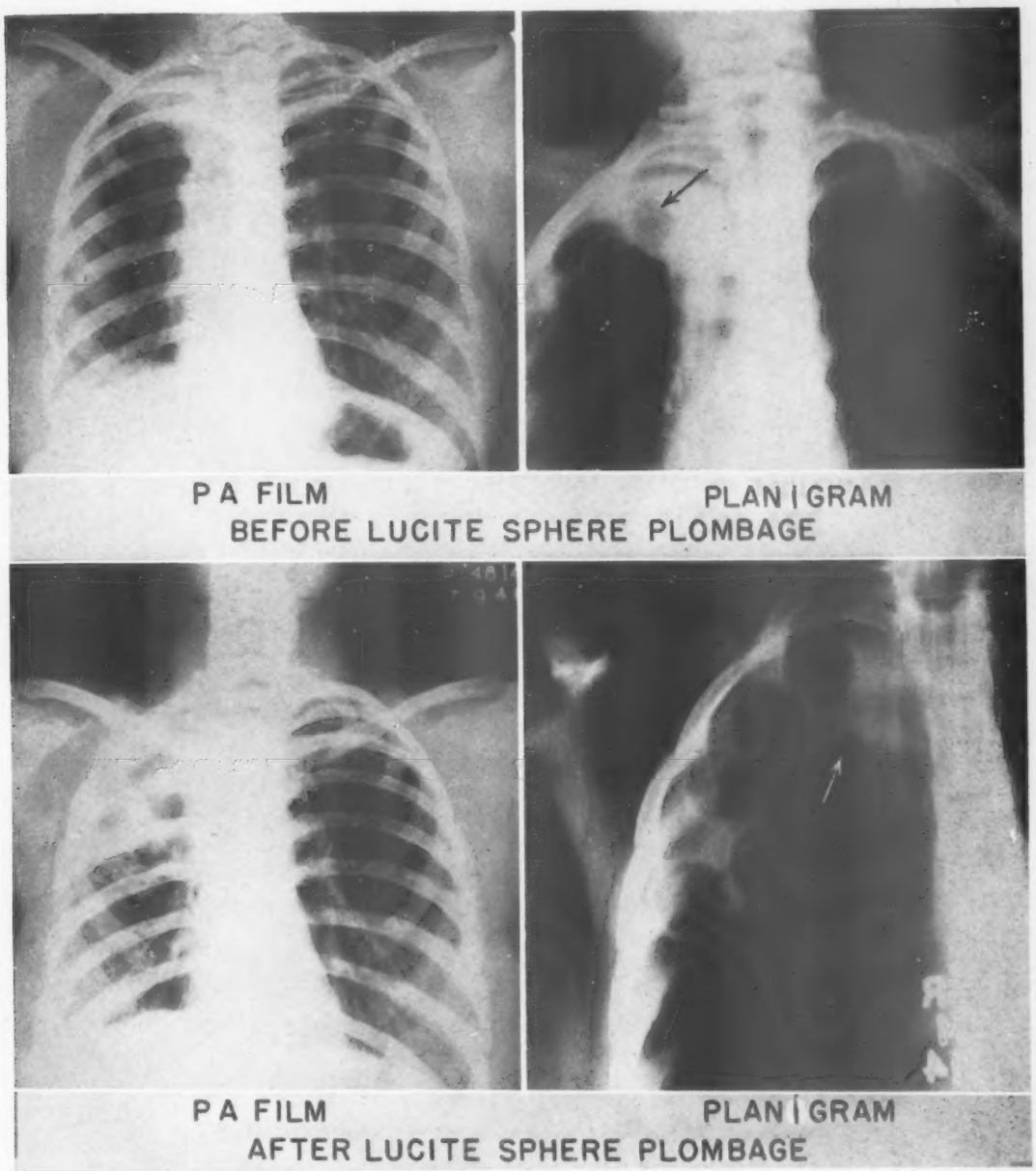

FIG. 6. Roentgenograms demonstrating cavity remaining after lucite sphere plombage (demonstrated only by planigram). The upper photographs show a plain film and a planigram before operation. The lower films taken after operation reveal the characteristic shadows of the lucite spheres with no definite cavity demonstrated on the plain film, and the cavity easily shown on planigraphic study.

culosis in poor risk and complicated cases, but which has fallen into disuse because of failure to find a suitable material that could be utilized for plombage. Methyl methacrylate (lucite) was found in experimental studies to be non-irritating, light, readily available, and well tolerated. It was apparently suitable for plombage, and has been given a clinical trial. The material has been used in the form of hollow spheres which are packed into the extrapleural space developed by apicolysis, and cast distinctive shadows on the roentgenograms. The procedure has been used unilaterally,

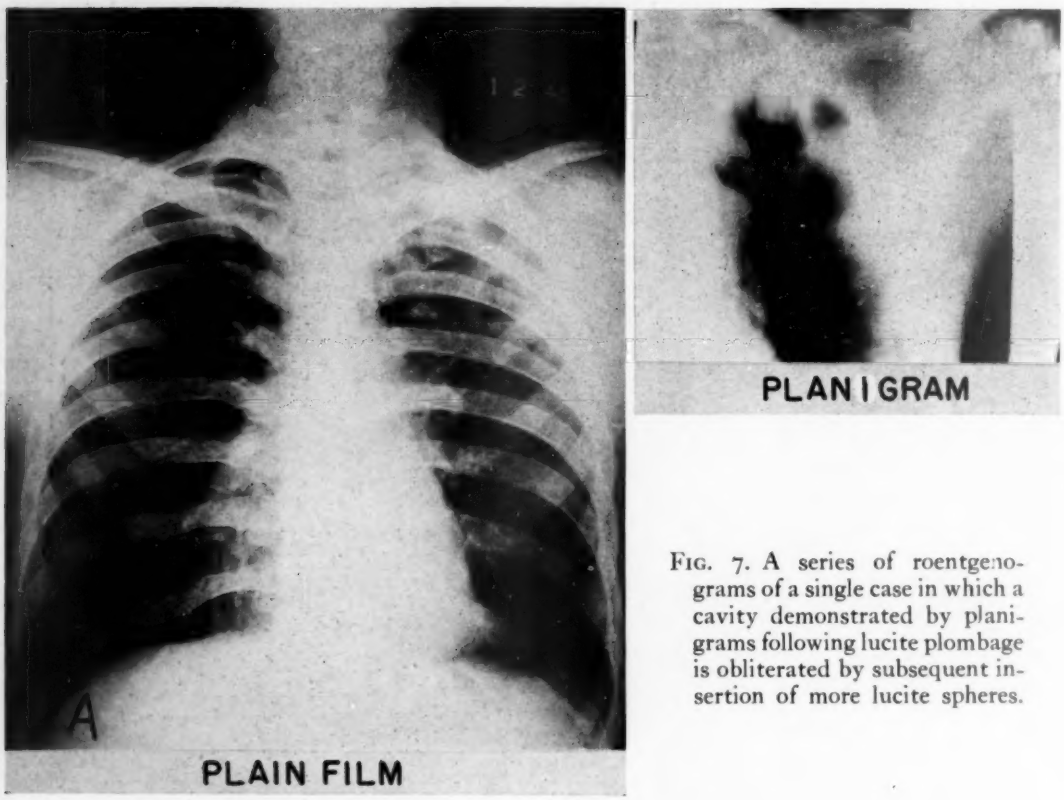

Fig. 7. A series of roentgenograms of a single case in which a cavity demonstrated by planigrams following lucite plombage is obliterated by subsequent insertion of more lucite spheres.

The films in (*A*) taken before operation show the lesion easily demonstrated by both plain film and by planigram. The roentgenograms in (*B*) following initial lucite plombage show the cavity only on planigrams. Note how the cavity (arrow) is compressed medially by the lucite spheres. The roentgenograms in (*C*) following subsequent insertion of more lucite spheres fail to demonstrate any evidence of cavitation either by plain film or planigrams.

bilaterally, and in combination or in conjunction with thoracoplasty. In all cases complete collapse and obliteration of cavities is not obtained, and because the hollow spheres which simulate multiple cavities make the demonstration of residual cavities by plain roentgenograms difficult, it has been found that planigraphy is of great value in the subsequent study of these cases.

SUMMARY

The roentgenographic aspects of a series of cases of pulmonary tuberculosis in which extrapleural pneumolysis procedures utilizing methyl methacrylate (lucite) spheres for the maintenance of collapse has been presented. Particular attention to the value of body section roentgenography in the subsequent study of these cases is emphasized.

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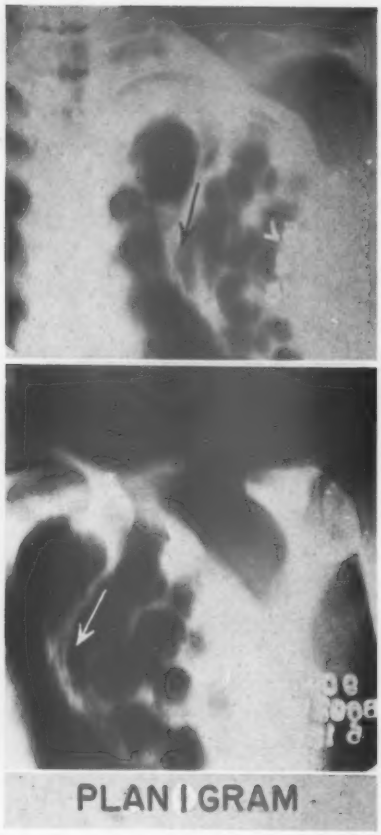
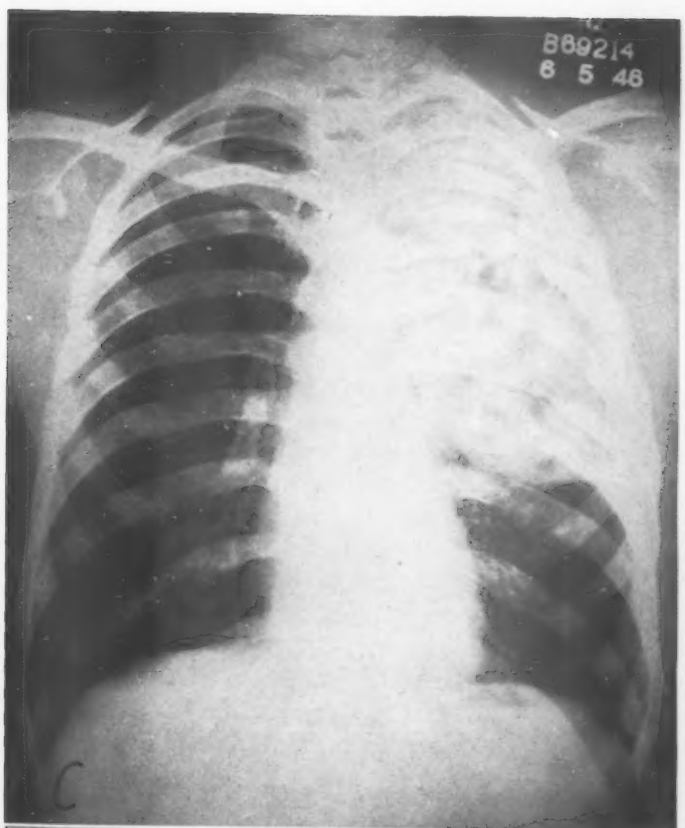
PLAIN FILM



PLANIGRAM



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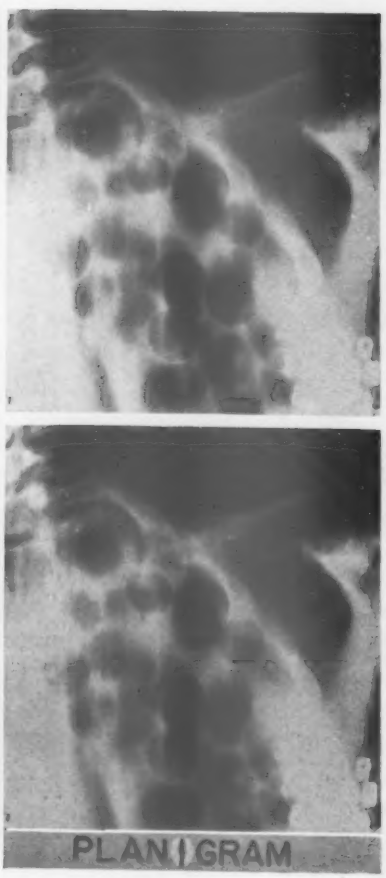

PLANIGRAM

PRIMARY CANCER OF THE LUNG WITH SPECIAL REFERENCE TO APICAL LUNG TUMORS*

By JUSTIN J. STEIN, M.D.
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THE similarity of the symptoms, physical signs, and of the roentgenographic findings in cases of primary cancer occurring at the apex of the lungs is a striking feature of the disease. This is in sharp contrast to the cases occurring at or near the hilum in which the onset of the disease may simulate numerous other conditions.

Tobias, in 1932, very ably described the syndrome produced by apical lung tumors as follows: "The painful apico-costo-vertebral syndrome is a symptomatic entity which establishes the existence of a process of neoplastic nature, and the syndrome helps to establish the early diagnosis of primary carcinoma of the lung." If Tobias had qualified his statement with the remark that, on occasion, other primary or metastatic tumors situated in the extreme apex of the lung might produce similar symptoms purely because of the anatomical location, his description would have been most complete.

It is amazing that although Hare in 1838 probably reported the first so-called superior pulmonary sulcus tumor it was not until 1924 and again in 1932 that further attention was directed to apical lung tumors by Pancoast. In 1924 he reported 4 cases of tumors occurring in the region between the root of the neck and the apex of the lung in which there occurred a peculiar clinical syndrome resulting from involvement of the brachial plexus and of the cervical sympathetic chain. This consisted of pain around the shoulder and down the inner side of the forearm of the affected upper extremity, atrophy of the muscles of the hand, and Horner's syndrome, namely, unilateral miosis, ptosis of the upper eyelid, enophthalmos and anhidrosis of the face and neck. In 1932 Pancoast added 3 new cases and republished the original cases. In this paper he stated that he believed the tumors arose from embryonal rests in the fifth pharyngeal pouch.

Pancoast designated these rumors as superior pulmonary sulcus tumors in that he believed a specific new clinical entity had been found. He further noted certain features which could be recognized roentgenographically, such as the presence of a sharply defined shadow at the apex of the lung, destruction of one or more of the upper three ribs posteriorly, and some erosion of the transverse processes and bodies of the corresponding vertebrae. There were no postmortem examinations made and in only 2 cases was biopsy material available for histopathological study. He stated that primary lung cancer could practically be ruled out. Although Pancoast's observations were incorrect as to etiology, he deserves great credit for stimulating interest in the study of apical lung tumors.

A typical patient with apical lung tumor presents the following symptoms and findings: A male about forty-six years of age with a presenting complaint of shoulder girdle pain of increasing severity of approximately six to eight months' duration. Later the pain radiates down the inner side of the arm into the ring and little finger of the hand. He becomes emaciated as a result of rapid weight loss and the severe pain. He walks with drooping of the affected shoulder and carries the affected arm in a more or less fixed position close to the chest with the elbow slightly flexed. The upper eyelid becomes ptosed and there is an absence of perspiration over one-half of the face and head. Cough is generally absent. His face reflects the agony of one who has suffered a great deal. Physical exami-

* From the Los Angeles Tumor Institute. Presented at the Second Inter-American Congress of Radiology, Havana, Cuba, Nov. 17–22, 1946.

nation reveals a Horner's syndrome on the affected side. There is atrophy of the muscles of arm, forearm, and hand. A mass can be palpated in the neck above the clavicle on careful examination. There is dullness to percussion over the extreme apex of the lung and diminution of the breath sounds on auscultation.

Roentgen examination reveals a well defined homogeneous shadow of increased density situated in the extreme apical portion of the lung. There is slight indentation and displacement of the trachea to the opposite side. Laboratory examination: Nothing remarkable. Clinical course rapidly retrogressive. Average length of life from onset to death approximately thirteen months.

In 1942,[11] I reported 12 new cases of tumors occurring in the region of the pulmonary apex and republished data regarding 15 previously reported cases, making a total of 27 cases observed during a six year period. Twenty-six of the cases were considered to be primary in the terminal bronchioles of the lung and 1 was metastatic to the pulmonary apex from an osteogenic sarcoma of the left femur. Histopathological data from biopsy or postmortem examination were obtained in 21 of the cases. The average age was 46.3 years. Cases have been reported from thirty years of age to the age of seventy-five. More than 95 per cent of the cases occur in men. The average duration of symptoms from onset to death was thirteen months. In the first 15 cases the diagnosis prior to admission was as follows: Tuberculosis in 4; tumor in 5; neuritis in 4; psychoneurosis in 1, and in 1 case no diagnosis was given. Cases have been reported who had tonsillectomies performed because it was thought that the shoulder pain was rheumatoid in origin. No evidence to substantiate a bronchiogenic origin has been observed by me or noted from reports in the literature.

One should be extremely cautious in procrastinating over the results of a series of only 2 or 3 cases. Only by a study of large numbers of cases of a single disease can we accurately gain knowledge of the life history of a disease and of the many variations present. For example, 1 case in this series lived for a period of thirty-two months and another for twenty-nine months, and so on; whereas the average for the whole series was only thirteen months, which corresponds with the figures given in many case reports. It would be easy to credit whatever treatment was given as causing the increased longevity if only a few cases were seen.

Symptoms are not produced as early in this type of lung cancer because obstructive bronchial changes such as is caused by the centrally located lung cancer do not occur. Also cough, hemoptysis and sepsis are unusual. Intrathoracic metastasis occurs but rarely. Hoarseness has been reported as a prominent feature by some authors.

Horner's Syndrome. Horner's syndrome is not essential for the diagnosis of a so-called superior pulmonary sulcus tumor. This syndrome depends entirely upon involvement of the cervical sympathetics. This may occur at any time. We have observed some patients for many months before Horner's syndrome became apparent. Its presence is a definite surgical contraindication.

Costal and Vertebral Changes. Costal and vertebral changes are not essential for the diagnosis since the time of their appearance is also variable and in the case of a benign neurofibroma it might never occur. When the costal and vertebral changes do occur, there is generally both a pressure necrosis and malignant infiltration of the bony structures about the tumors.

Shoulder Girdle Pain. Severe shoulder girdle pain generally means involvement of the brachial plexus and therefore complete surgical extirpation of the lesion is impossible. Pain is almost always the first symptom of the disease and is both superficial and deep in character. It may begin in the posterior shoulder region, the anterior shoulder region or in the axilla or arm. It is generally referred to as a gnawing, knife-like or boring pain.

TREATMENT

Surgery. The complete removal of these tumors must take place before extension into the mediastinum or brachial plexus has occurred. This automatically restricts surgery to a very few of the tumors. Recently, while serving on active duty in the United States Navy, I had occasion to follow the course of 2 patients which serves to emphasize early surgery and of early investigation of the apical region in patients who have shoulder girdle pain. One of the patients was thirty-seven years of age. Some years previously, he had been told that he had a tumor in the left apex, the nature of which was not determined at that time. He had shoulder girdle pain which was mild and not constant. More recently the pain had become quite severe and he developed a Horner's syndrome and destructive changes in the second and third ribs posteriorly and adjacent portions of the vertebrae. At surgical exploration it was impossible to remove the tumor and a biopsy revealed it to be a neurogenic sarcoma. Coincidentally, a twenty-three year old premedical student who was a seaman in the Navy was a patient in the hospital at the time because of shoulder girdle pain and the presence of a dense homogeneous shadow at the apical portion of the lung. Horner's syndrome and costovertebral changes were not noted. Since he had watched the operation on the previously described patient, he readly consented to surgery and a neurofibroma was removed in its entirety. Had the first patient consented some time before to surgery, he would have been cured.

Irradiation. Radiation therapy has been disappointing. The tumors are radioresistant and are not complicated by secondary infections as compared with cancer of the lung in general, where definite palliative results may be obtained by irradiation. Cases have been presented where there has been regression of the tumor and some diminution in the pain only to recur a short time later. Some of the cases reported in the literature as responding to irradiation were not followed long enough for an adequate study. Several of my patients living the longest periods of time had obtained no regression of their tumors or diminution of the pain following irradiation. Some of the patients received very large total doses without benefit. Irradiation should be prescribed for every patient who is not operable, to give the patient the benefit of the doubt. External irradiation followed by the implantation of radon seeds was also tried without appreciable prolonged benefit.

Special Procedures. (1) Paravertebral alcohol injections have been tried without much benefit. (2) Chordotomy is a hazardous procedure and the results may be unsatisfactory. (3) Multiple posterior root section will produce a useless upper extremity but may give relief from the pain in some of the cases.

DISCUSSION

Metastatic lesions from the breast, kidney, adrenal, pancreas and from the stomach have been reported as causing this syndrome; also thymic tumors and intrathoracic sympathoblastoma.

The preponderance of evidence to date is that the great majority of malignant tumors in the region of the thoracic inlet or pulmonary apex are primary carcinomas arising in the terminal bronchioles of the lung.

The characteristic symptomatology of brachial plexus and cervical sympathetic involvement is a late manifestation of the disease.

The first symptom in practically all cases is shoulder girdle pain which sooner or later radiates down the arm. Patients having shoulder girdle pain should have a roentgenographic examination instead of being treated for rheumatism, arthritis, neuritis, bursitis, and so forth for months before adequate examinations are made.

In the presence of a primary tumor in the apex without Horner's syndrome or apparent brachial plexus involvement, a sur-

gical investigation should be done. Neurofibromas or other benign lesions and possibly very early primary cancers of the lung could then be adequately removed.

With regard to primary cancer of the lung in general there has been a real as well as a relative increase. The lung ranks second only to the stomach as a primary site of cancer.

In the diagnosis of primary cancer of the lung the single most important diagnostic procedure is a roentgenographic examination of the chest. Although one should never attempt to diagnose cancer of the lung positively by roentgenographic examination alone, sufficient data can generally be obtained to warrant further study.

Bronchoscopy should be resorted to in order to obtain a specimen for histopathological study. Since approximately 85 per cent of primary lung cancers are situated at or near the hilum, it will be possible to make a positive diagnosis in a high percentage of cases by this method. In some of the more peripherally located tumors where biopsies cannot be made, valuable information, such as evidence of immobility, narrowing, and deformity of the bronchi will be obtained.

With regard to exploratory thoracotomy, if doubt exists concerning the question of operability, exploratory thoracotomy should be done. The mortality from this procedure is negligible. We have no hesitancy in performing exploratory laparotomies in cases of questionable intra-abdominal lesions. Without surgery the death rate is always 100 per cent in lung cancer.

Graham has not had a case presenting even a clear pleural effusion live longer than six months following pneumonectomy, and he is of the opinion that pleural effusion either bloody or clear probably contraindicates operation. Bloody pleural fluid is definitely a sign of inoperability.

In peripherally located tumors where it is difficult to obtain tissue for histopathological study, aspiration biopsy under roentgenoscopic control may be done. It is believed that the question of leaving tumor implants is more theoretical than practical. Occasionally this will be the only means by which a diagnosis can be made.

Total pneumonectomy is the only procedure which will adequately remove the primary lesion and the regional lymph nodes which drain that lesion. Ochsner and DeBakey found the incidence of metastasis to the regional lymph nodes in 3,047 collected cases of cancer of the lung to be 72.2 per cent. In a series of 100 autopsied cases which Joslin and I[12] reported in 1938, the evidence of metastasis to regional lymph nodes was 63 per cent. Lobectomy is certainly a totally inadequate procedure.

I am convinced that primary cancer of the lung is a surgical problem until inoperability is established. We must remember that it has been only thirteen years since Graham performed the first successful pneumonectomy for primary cancer of the lung and this patient is still living at the last report. Since that time numerous pneumonectomies have been done and the operative mortality is steadily decreasing in the hands of experienced chest surgeons. The early mortality has been high but constant improvement in technique and selection of cases has occurred. For example, Shenstone performed his first 4 pneumonectomies before 1938 and all proved fatal. Since 1938 he has reported 9 cases of total pneumonectomy for bronchiogenic cancer with only 2 deaths. Graham reported a series of 75 total pneumonectomies, in which 70 were for carcinoma. There were 20 deaths in the hospital, or a mortality of 30 per cent. In the last 25 cases, there were only 3 deaths, or a mortality of 12 per cent. Rienhoff reported a series of 71 total pneumonectomies for primary cancer of the lung in which there were 15 deaths in the hospital, or a mortality of 21 per cent. There was a succession of 17 cases in his series in which there were no deaths. From the above figures, it can be seen that much of the prevailing pessimism regarding surgery is not justified. We have only to compare these

figures with those for colon and gastric surgery and then we must realize that chest surgery for cancer of the lung is in its infancy. With the use of the newer drugs and with the establishment of chest centers over the country, the technique of the operation will continue to improve resulting in a further reduction in the mortality rate.

For the inoperable cases of primary lung cancer, radiation therapy is of definite palliative value. Radiation therapy reduces the inflammatory complications produced by the bronchostenosis thereby resulting in general clinical improvement of the patient. The average duration of life in a group of 66 treated cases where it could be accurately determined was 15.2 months. Forty-eight cases in which the average duration of life could be ascertained, and who received only symptomatic treatment, lived for only 8.7 months.[12] Many additional cases have been observed since this study with similar results. If very large total doses of radiation are given in an attempt to destroy the lesion, we have found that the pneumonitis and the resulting fibrosis probably hasten the final outcome. The routine use of radiation therapy is advocated for all inoperable cases.

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ESOPHAGEAL HIATUS HERNIA WITH INVERSION OF THE STOMACH

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HERNIAS through the diaphragm continue to present interesting and occasionally unusual problems. The more common types have come to be well recognized during the past twenty-five years, and the steadily increasing frequency of rotengen examination has shown them to be present in relatively large numbers. They have been found in patients with a wide variety of symptoms, and it has been shown that there is no constant relationship between the size of the hernia and the magnitude of the symptoms. The previously existing divergence of opinion as to what proportion of cases should be subjected to surgery for repair has gradually disappeared as the results of surgery have been improved.

The recent rapid strides in thoracic surgery with the short period of hospitalization and the early return to normal function make it imperative that we become familiar with even the more infrequent types of diaphragmatic hernia. Such familiarity would permit adequate repair during a period of election and thus avoid the high mortality of emergency surgery during a period of shock.

A case of inversion of the stomach within a hiatus hernia was reported by me in 1937[3] but the potential danger of the inversion was not appreciated at that time. The patient had had symptoms for about six years, and at the time of our examination the fundus of the stomach was in the abdomen although its antrum was in the left chest. Both portions of the stomach were greatly dilated and there was a forty-eight hour residue in spite of aspiration. The unusual position of the stomach was interpreted as indicating that the hernial orifice was lateral to the hiatus esophageus, but at operation it was shown that this was not true. The hernia was actually through the hiatus esophageus which was normally placed but greatly dilated. It was then learned that roentgen examination done about five years earlier had shown only the fundus of the stomach involved in the hernia. It appears, therefore, that inversion of the stomach occurred at some time after the hernia had become manifest.

In that same year Bowen[1] reported a somewhat similar case in a male, aged forty, who had had recurrent attacks of pain in the left chest, dyspnea and vomiting over a period of eight years. Roentgen examination had shown a rather large hernia with the stomach and a portion of the transverse colon in the chest. The patient died about forty-four hours after the onset of an acute attack, and autopsy showed that the stomach was twisted upon itself with constriction at both the cardia and pylorus. The position of the pylorus was higher than that of the cardia and the stomach contained 4 quarts of blood-stained fluid. Portions of the colon and omentum were also in the left chest.

Two additional cases were reported in 1944. One[2] was of a woman, aged fifty-seven, who had been known to have a hiatus hernia for at least four years. She was hospitalized because of acute pain in the left chest accompanied by ineffectual attempts at vomiting. At operation the hernia was reduced and immediately thereafter the stomach was seen to turn from right to left. It was distended to a measurement of about 9 by 20 inches. Sutures were placed in the hiatus and she made a complete recovery. The other case[4] was of a woman, aged sixty-six, who had been thought to have a hiatus hernia of the usual type for about two and a half years. She was seen about three days after the onset of an acute

Fig. 1. Case 1. Lateral view of the spine taken elsewhere about eighteen months before the terminal episode. Note the gas bubbles above and below the diaphragm.

attack in a drowsy and uncooperative state. There was eccentric convexity in the left upper quadrant of the abdomen and the stomach was found to contain 3,100 cc. of fluid. Roentgen examination on the following day showed the fundus of the stomach below the diaphragm and the antrum above it. The duodenum was obstructed. Operation was done two days later and she was subsequently discharged, free of difficulty.

We wish to report 2 additional cases of inversion of the stomach within a hiatus hernia.

Case 1 (NEDH 119,035). A housewife, aged fifty-six, was first seen as an office patient by Dr. F. W. Marlowe on January 11, 1943, because of backache. The backache had been present for about two years and had been associated with cramps in her legs. She believed that her appetite was good but stated that she was troubled with "gas after meals." Physical examination at that time was negative except for evidence of arteriosclerosis and an exaggeration of the normal thoracic and lumbar curvatures. Roentgen examination of the spine was made at that time at another hospital. That examination showed evidence of osteoporosis. A diagnosis of hiatus hernia was also made because of a rather large gas bubble which was seen behind the heart. A high calcium diet was prescribed together with supplementary vitamins. She was seen on several occasions during the next few months but there were no new symptoms or changes in the physical examination.

During the summer of 1944 she had a few osteopathic treatments against the advice of her physician. One such treatment was given during the evening of August 17, following a hearty meal, and in spite of some nausea which had followed the meal. She was wakened from sleep during the night and called her physician because of nausea with pain in the region of the left costal border. She was seen at 3:30 A.M. sitting erect in bed. She complained of some dizziness and stated that the pain was worse if she attempted to lie down. Examination showed a temperature of 97° F. with pulse of 100 and blood pressure of 160/100. Heart

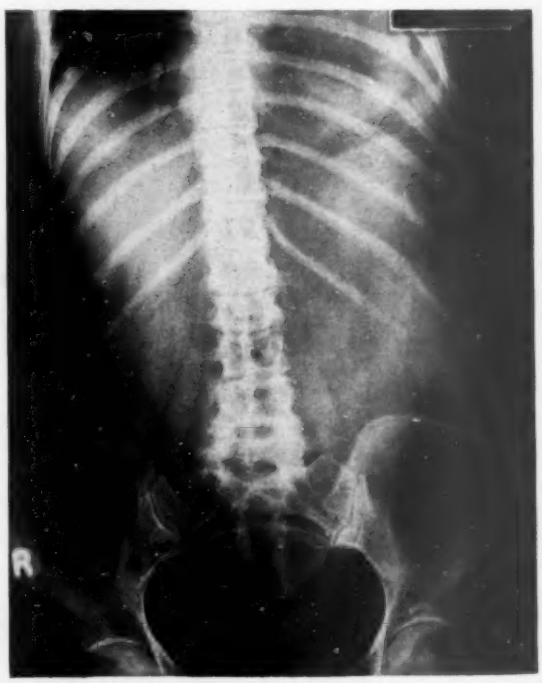

Fig. 2. Case 1. Supine roentgenogram showing the large mass which contained both fluid and gas.

sounds were of rather poor quality but no murmurs were heard. There was a sense of resistance in the left upper quadrant of the abdomen but no definite mass was felt. Immediate hospitalization was advised but was refused. She was given 15 mg. of morphine for relief of pain. When seen six hours later she seemed somewhat more comfortable but examination then showed a definite mass in the left upper quadrant. Temperature was normal, pulse was unchanged and the total white blood cell count was 10,500. Hospitalization was again refused. Further medication was withheld in the hope that she would soon consent to be moved. This she did late in the evening of the same day. At the time of admission to the hospital the mass filled the epigastrium and left hypogastrium and was so firm that it was difficult to define the costal margin. There had been no vomiting or diarrhea.

On the morning of August 19 the mass was even larger, the patient was slightly cyanotic and the pulse was of rather poor quality. Roentgen examination then showed the mass in the left side of the abdomen which extended down to the level of the iliac crest. A second, smaller mass was shown behind the heart, and upright roentgenograms showed a fluid level within each mass. One fluid level was situated posteriorly at the level of the ninth thoracic vertebra and the other anteriorly at the level of the eleventh thoracic vertebra. The left diaphragm was poorly shown but it was believed to lie between the two fluid levels. It was also believed that both fluid levels were within a greatly dilated stomach and that the dilatation was the result of inversion within a hernial sac. A small amount of barium by mouth confirmed these impressions. The esophagus was displaced slightly toward the right by the mass behind the heart and was narrowed as it passed through the diaphragm. It emptied into the distended portion of the stomach which lay in the abdomen.

Fig. 3. Case 1. Erect roentgenogram showing fluid levels above and below the diaphragm.

Fig. 4. Case 1. Supine roentgenogram after ingestion of small amount of barium. The large abdominal mass is now shown to be the greatly dilated cardiac end of the stomach. The antrum of the stomach is in the left chest posteriorly and displaces the esophagus to the right.

Patient was operated upon by Dr. Leland S. McKittrick. About 4 liters of fluid and undigested food particles was removed from the stomach through a trocar. Following this, the hernia was easily reduced by gentle traction. The hernial orifice admitted three fingers easily and did not constrict the stomach after the abdominal loculus was emptied. Repair was not attempted because of the poor condition of the

FIG. 5. Case II. The inversion of the stomach is similar to that of Case I except for the absence of severe dilatation.

patient. Respiratory embarrassment was temporarily relieved following operation, but she continued to be in a state of shock in spite of measures to combat it and died at 10:30 A.M. on August 20.

CASE II (PMH 46:1540). A married woman, aged forty-nine, was admitted to the hospital on October 23, 1946, because of pain beneath the left costal margin. This pain had been first noted about one year before and usually came on after meals. During the first few months it had been partially relieved by belching. Roentgen examination made elsewhere about one month after onset of symptoms was said to have shown a diaphragmatic hernia.* Vomiting was first noted about seven months before admission but had disappeared during a two week period of medical treatment in another hospital. About ten days before admission to the Deaconess Hospital the vomiting recurred, was very forceful and was not related to meals. She had taken no food by mouth during this period but had been maintained in satisfactory chemical balance by intravenous fluids.

*We have been permitted to see these roentgenograms and have found them to be identical with our own.

Roentgenoscopic examinations in the upright position showed a large gas bubble behind the heart and a much smaller one beneath the left diaphragm. Unfortunately an upright roentgenogram was not taken for record of these collections of gas. Barium was given by mouth and showed the esophagus to be of normal length and emptying into the stomach just below the diaphragm. Approximately one-third of the cardiac end of the stomach was in this position but the major portion of the stomach was above the diaphragm and behind the heart. Its greater curvature was uppermost but its contour was smooth, and feeble peristaltic waves were seen. The pylorus and duodenal cap were just to the left of the midline and immediately below the diaphragm. The second portion of the duodenum was normally placed.

Transthoracic operation was done by Dr. Richard H. Sweet. More than half of the stomach and much of the omentum were found within the hernial sac which was adherent to the other tissues of the mediastinum. The hernia was reduced, the sac removed and the defect closed with silk sutures. The patient was discharged, free from symptoms, on the eighteenth postoperative day.

We very much regret the fatal outcome of the first case since it now appears quite probable that a favorable outcome might have been obtained had the patient been willing to accept hospitalization at an earlier time. It is of particular interest that the roentgenograms of the spine which had been taken eighteen months prior to the acute episode had shown gas bubbles both above and below the diaphragm, although only the one above the diaphragm had been noted. Our own experience and a rather careful search of the literature have failed to show a single case of hiatus hernia of the usual type in which more than one gas bubble was present. In hernias which involve only a relatively small portion of the fundus of the stomach the single gas bubble, if present, is found below the diaphragm. In those which involve larger portions of the cardiac end of the stomach, and especially if adhesions are present about the hiatus, the single gas bubble is frequently found above the diaphragm. It is usually on the

left side and behind the heart, but may occasionally be on the right side.

It thus appears that inversion of the stomach should be seriously considered whenever the double gas bubble is found, and even before barium is given. If such a condition is suspected, early confirmation by barium studies should be strongly urged. If inversion is shown to be present, surgical repair should be undertaken very soon in the hope of avoiding the unfortunate sequence of strangulation and acute dilatation of the stomach.

Occasional cases of hiatus hernia may also be seen in which there is rotation of the stomach through an axis in the coronal plane, but in which the fundus remains above the diaphragm and the antrum below it. The 2 following cases are representative of this type of rotation:

Case III (PMH 46:1517). A married woman, aged seventy, was admitted to the hospital on October 20, 1946, under the care of Dr. Allen G. Brailey. Her complaints were of weakness, unsteadiness of gait and pain in her legs. These symptoms had had their onset about one year before and had gradually become more severe. There was no weakness or paresthesia of the upper extremities. She had occasionally had some substernal pain with effort, but this pain did not radiate and was relieved by nitroglycerine.

Significant features in the physical examination included the following: pale skin and mucous membranes; blood pressure of 210 systolic and 115 diastolic without cardiac murmurs; absent knee jerks, ankle jerks and plantar reflexes; and positive Romberg test.

Laboratory studies showed 4,190,000 red blood cells and 8,350 white blood cells per cubic millimeter, with 10 grams hemoglobin per 100 cc. Differential white blood cell count was normal except for 7 per cent eosinophils. Gastric analysis showed free hydrochloric acid as high as 45 units in one specimen, with occult blood in all specimens.

A consultant is neurology believed that there was evidence of damage in the posterior columns of the spinal cord and that this was probably due to the hypertension, arteriosclerosis and secondary anemia. He believed that the treatment was that of the anemia.

Fig. 6. Case III. The entire stomach is within the hernial sac and the greater curvature is uppermost.

Roentgen examination of the chest was done as a routine procedure and showed no abnormality of the heart or lungs. An oval area of radiolucence was easily seen behind the heart and measured about 9 by 11 cm. This shadow was assumed to represent a gas bubble in the stomach within a hiatus hernia and subsequent studies with barium by mouth confirmed this, as indicated in Figure 6. A gas bubble was not shown in the portion of the stomach below the diaphragm. Barium enema showed that the colon was not involved in the hernia.

Because of her age and poor general condition it was deemed unwise to operate on this patient. She has improved slightly on a medical regimen with added iron.

Case IV (NEDH 135,212). A married woman, aged forty-four, was admitted to the hospital on November 26, 1946, because of "stomach trouble" of one and one-half years' duration. Her original symptom was that of epigastric pain which was made worse by eating. This distress had gradually become more severe and during the few months just prior to admission she had vomited two or three times each week. The vomiting usually occurred following the evening meal. She had lost approximately 40 pounds during her illness but physical examina-

tion was negative except for evidence of weight loss.

Roentgen examination showed a hiatus hernia with the position and contour of the stomach almost identical with the preceding case shown in Figure 6.

Operation was done through an abdominal incision by Dr. Bentley P. Colcock of the Lahey Clinic. All of the stomach except for a short segment of the pyloric antrum was found within the thorax together with a large portion of the omentum. The gallbladder was absent as a result of a previous operation but no other abnormality was noted. The hernia was easily reduced and the hiatus was sutured until it would admit only one finger. Removal of the appendix was also done. Convalescence was uneventful and the patient was discharged to her home on the eleventh postoperative day.

It is possible that the type of hernia seen in the last 2 cases represents a transition between the very common hiatus hernia which involves only the fundus of the stomach and the type first noted, in which there is a complete inversion of the stomach within the hernial sac. We have not had an opportunity to follow this sequence of events.

CONCLUSION

It is our belief that many hiatus hernias which involve only the fundus of the stomach do not give rise to symptoms or signs sufficient to warrant surgical repair. We believe, however, that when rotation of the stomach occurs within the hernial sac the indications for surgery are definitely increased, and that if actual inversion is present the danger of strangulation and acute dilatation is real.

Inversion of the stomach within a hiatus hernia should be strongly suspected if gas bubbles are seen both above and below the diaphragm in any roentgen examination of the lower thorax or upper abdomen.

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POUCH FORMATION FOLLOWING GASTRO-ENTEROSTOMY*

By LIEUTENANT COMMANDER ERNEST LANDY (MC) USNR

THE operation of gastroenterostomy has since its inception been the subject of much controversy concerning the indications for this procedure, especially in the light of the numerous poor results and complications that followed.

This is evidenced by the voluminous literature that has been written on the subject. My interest in this condition was due to persistence of symptoms in a group of patients that had gastroenterostomies for peptic ulcer done over a period of years with notable unimprovement of their symptoms and, in many, actual increase in their discomfort. This group had been hospitalized on numerous occasions at various hospitals. The operative procedures were done by different surgeons in various institutions for peptic ulcers.

These patients, in addition to recurrence of symptoms, had complications such as recurrent hemorrhages, new or recurrent ulcers, perforations and obstructive symptoms.

It is the purpose of this paper to present a phase of the problem which may have a bearing on the malfunctioning of the gastroenterostomy that was noted in these cases.

The causes that have been ascribed to the malfunctioning of a gastroenterostomy have been varied and numerous, some controversial. Indeed, as noted by Bevan, at operation an excellent gastroenterostomy stoma was found and no cause for the patients' symptoms or malfunction found. The question naturally arises whether there is a functional derangement preventing the gastroenterostomy from functioning properly.

Some of the factors responsible for poor results mentioned in the literature are as follows:

Faulty Preoperative Management or Selection of Cases:

Omitting to treat chronic duodenitis or gastritis especially when marked.
Failure to eradicate foci of infection.
Failure to correct blood chemistry deficiency such as alkalosis prior to operation.
Failure to aspirate, irrigate stomach and to use dietary measures in cases of dilatation of the stomach.
Must be definite indications for this operation. Gastroenterostomy functions best when there is obstruction at the pylorus.
Unnecessary operation in a patient with achlorhydria.

Errors in Operative Technique:

Improperly placed stoma.
Stoma too close to pylorus or too highly placed, or stoma too distant from pylorus in an atonic stomach.
Use of non-absorbable suture material acting as a foreign body.
Stoma too small.
Stoma too large forming a so-called "dumping" stomach by which food passes into jejunum, overloading it and causing a "gastrocolic reflex."
Too narrow an attachment at stoma permitting an acute angulation.
Pressure on middle colic artery.
Too large an area of bowel wall used in anastomosis making possible the formation of pouches (Finsterer).
Too short a jejunal loop causing a kink by binding stomach to spine.
Too large a proximal jejunal loop causing stasis, vomiting and regurgitation.
Opening made into distal pouch in case of hour-glass stomach with junction too short or incorrectly sutured.
Opening in mesocolon incorrectly placed, e.g., too close to colon.
Opening in mesocolon too small or left unsutured.
Stitching opening in mesocolon to jejunum or to the anastomosis and not to the stomach.
Suture edges not inverted.
Faulty suturing.

* From the U. S. Naval Hospital, Balboa, C.Z.

Anastomosis too tight.
Interrupted sutures used throughout.
Tying knots too large.
Sutures drawn too tightly.
Clamps applied too tightly.

Anatomical Factors:

Rigid and short mesocolon.
Obesity of patient.
Too high a fixation of the mescolon.

Pathological Conditions:

Swelling of mucosa about stoma with development of a jejunitis or stomal ulcer.
Pouching of gastric mucous membrane about stoma.
Gastrojejunal ulceration.
Gastric ulcer developing following operation.
Jejunogastric intussusception.
Pylorus again becoming functional following operation as a result of subsidence of edema and inflammatory swelling.
Volvulus of jejunal loop.
Pathological processes in stomach preventing it from emptying.
Recurrent ulcerations.
Internal herniations.
Adhesions about stoma.
Hematoma or hemorrhage about stoma.
Failure to excise, cauterize, or remove a chronic gastric or duodenal ulcer if present.
Failure to remove a septic intra-abdominal focus when present, such as a chronic appendicitis or a chronic gallbladder condition.
Duodenal ileus.
Faulty postoperative management.

Other Conditions that May Contribute to Malfunction:

Defective emptying time of stomach due to loss of muscle tone.
Deficiency in chymification and maceration.
Digestive deficiency from lack of enzymes.
Vitamin B deficiency.
Failure of stoma to develop sphincteric action causing so-called "gastroduodenal reflex" of Kelling; that is, food entering the duodenum fills it and prevents stomach from emptying.
Constitutional asthenia.
Age of patient.
Nervous intestinal hypermobility.
Late development of anemia.
Hypoproteinemia producing edema of stomach wall.
Unknown causes. At operation or postmortem excellently formed gastroenterostomy may be present yet with a poor functional result.
Poor motor function of stomach.

Following gastroenterostomy, obstruction at pylorus may become relieved due to the subsidence of edema and inflammatory reaction. After the operation symptoms in these cases may be improved, at first; however, later, the removal of the obstruction factors at the pylorus, a poor functioning of the gastroenterostomy may result.

In the following series of cases the patients had a gastroenterostomy performed for duodenal ulcer and without exception presented numerous symptoms over a period of years. Not only were the symptoms usually unrelieved by the operative procedure, but in addition they developed many new symptoms and were hospitalized on numerous occasions or were on medical treatment most of the time. The roentgen findings consisted of small pouches located about the stoma, or in some cases the pouches were formed by larger segments of the stomach wall. The latter apparently were due to spasm about the stomal site, by which the enterostomy opening apparently was "drawn up" toward the lesser curvature forming two large pouches of the stomach. The "local pouches," that is, the outpocketings surrounding the stoma tended to form on all sides of the opening. In the most marked cases noted, there was considerable obstruction at the site of the enterostomy opening, so that the barium could not pass through the stoma, although the barium went through the pylorus into the jejunal loop and apparently little could re-enter the stomach or pass through the efferent jejunal loop.

The location of the stomas in these cases varied, some were near the pylorus, some higher up on the greater curvature and some were in the most dependent portion of the stomach in the recumbent position.

The sites also varied with the position of the patient.

The pouch formation was not noted on all examinations and it was necessary to place the patient in various positions to demonstrate them, as they could be easily overlooked. The pouches also varied with the state of filling of the stomach. In some cases the pouches were outlined with a small amount of barium, and in others they were more pronounced with larger quantities of barium in the lumen. These pouches varied with the state of filling of the stomach and their inconstant character and size showed them to be functional. Finsterer and Paterson stated that pouches could be formed in a gastroenterostomy by the suturing of too large an area of the wall of the stomach and jejunum; however, the inconstant nature of the pouches would mitigate against this view in these cases. During roentgenoscopy, some of these pouches could be seen to fill and empty, and it is possible to confuse a small pouch with an ulcer niche. However, the appearance of the pouches and their behavior roentgenoscopically should help in the differentiation. The presence of pouch formation, especially when marked, was accompanied by symptomatology usually of an obstructive nature. The possibility that these pouches obstructed the stomal site is evident. The relationship of pouches to the formation of a stomal ulceration should be considered. According to Quigley, prolonged contact of food with the gastric mucosa exaggerates the gastric phase of gastric secretion and a gastric juice of high concentration develops. Experimental stagnation of gastric contents produced by folding the anterior gastric wall results in the formation of typical ulcer. There have been cases reported of gastric ulcer caused by diaphragmatic hernia in which stasis resulted.

Case 1. W. D. Patient has had pain and distress since 1918. In 1931 he was seized with an acute abdominal pain and a laparotomy was done and a gastroenterostomy was performed. The patient felt better for almost one year,

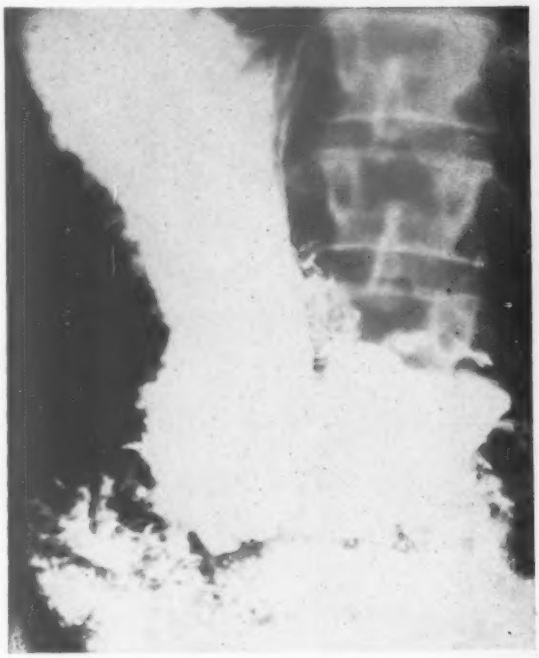

Fig. 1*A*. Case 1. 1935. No pouch seen on the filled stomach.

then developed epigastric pain and tenderness. The distress he attributed to overexertion and the symptoms had little or no relationship to his meals. In 1935 he entered the hospital and a

Fig. 1*B*. Case 1. 1935. Small pouches seen on nearly empty stomach about stoma.

Fig. 2*B*. Case 1. 1943. Pouches about stomach site in various sizes during emptying of the stomach.

gastrointestinal roentgen series was done. The stoma was functioning fairly well. There was a 10 per cent retention of barium in the stomach after six hours. The duodenal bulb showed a constant deformity. The stoma in the prone position appeared to be somewhat above the most dependent portion of stomach. Small pouches are seen just above the stoma (Fig. 1, *A*, *B*). In 1937 he again entered the hospital complaining that his "stomach backs up, and stuff comes into his mouth." Roentgen examination showed similar findings to that in 1935. He also stated he had three attacks of hematemesis since the last hospitalization and he now has constant soreness over his abdomen, but no definite tenderness. The gastric analysis at that time showed a free acid varying from 0 to 28 and a total acidity varying from 9 to 38. The blood count was normal. After a regimen of medical management and bed rest, he left the hospital feeling improved. Here again entered the hospital in 1943 stating he had never been free from distress since the previous hospitalization and for the past three months vomited from one to three times a day, almost one or two hours after meals. He had lost almost 8 pounds during the last few weeks. Blood picture was normal and his gastric analyses showed a free acid varying from 30 to 40, and a total acidity varying from 30 to 44. Roentgen examination showed a deformed cap with considerable dilatation of the duodenum. Well formed pouches can be seen which apparently obstruct the stoma (Fig. 2 *A*, *B*).

Fig. 2*A*. Case 1. 1937. Small pouches seen on nearly empty stomach about stoma.

Case II. J. H. In 1936 he first noted distress following meals which gradually became worse. The patient began to consume large quantities of whiskey and wine for relief with no success. He had several attacks of hematemesis and was treated for this in several hospitals. In 1938 a gastroenterostomy was done. He had no relief following the operation and again had several episodes of hematemesis, for which he was treated at various institutions by dietary and medical regimen and was hospitalized for a total period of almost seven months. He entered this hospital complaining of abdominal pain, hematemesis and diarrhea. The blood picture showed a secondary anemia and his gastric analysis showed a free acid varying from 11 to 18. The roentgen examination showed a deformed bulb with a prepyloric spasm. The gastroenterostomy opening functioned fairly well. Pouch formation was noted about the stoma (Fig. 3, *A*, *B*). He left the hospital against advice. He returned, however, several days later following an attack of acute abdominal pain

with board-like rigidity of his abdomen. Operation revealed a perforated duodenal ulcer. He recovered from this procedure and was again discharged.

Case III. W. L. This patient has had a long siege of abdominal distress and hospitalizations since 1919. In 1926, a gastroenterostomy was performed for ulcers. His distress continued, however, and he was again operated upon for removal of ulcers. In 1935, roentgen examination showed a pyloric defect apparently the result of a plastic operation. The barium passed through both the pyloric opening and the gastroenterostomy opening. There was marked spasm about the opening, causing an hour-glass appearance with pouch formation of the entire stomach on either side of the opening (Fig. 4, *A*, *B*, *C*).

Fig. 3*A*. Case II. Retouched pouch formation about stoma.

Fig. 3*B*. Case II. Tracing showing pouch of Figure 3*A*.

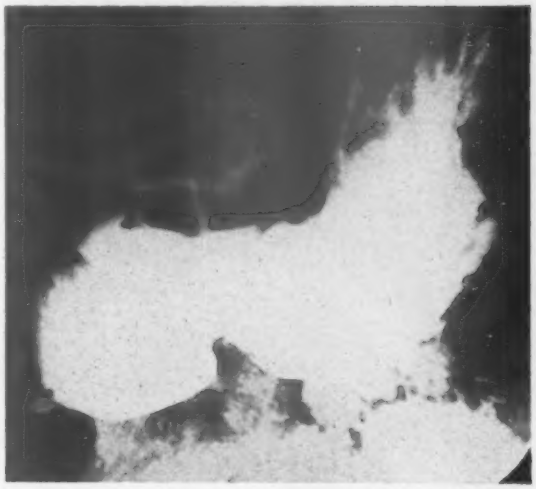

Fig. 4*A*. Case III. Various stages of spasm about stoma producing "hour-glass-like" deformity and pouches of stomach.

Fig. 4*B*. Case III. Various stages of spasm about stoma producing "hour-glass-like" deformity and pouches of stomach.

Fig. 4*C*. Case III. Various stages of spasm about stoma producing "hour-glass-like" deformity and pouches of stomach.

Case IV. E. F. This patient has had periodic attacks of epigastric distress since 1918. Had an appendectomy 1916. In 1921 had an operation for a perforated duodenal ulcer. The ulcer symptoms, however, continued and in 1930 a posterior gastroenterostomy was done. He felt well for almost a year following which ulcer symptoms again appeared and have been recurrent ever since. Free acid was 38, total acidity 54. Blood picture normal. Roentgen examination showed a small amount of retention after six hours with pouch seen when stomach was almost empty.

Fig. 5*A*. Case VII. Pouch formation about stoma apparently due to weight or pull of jejunal loop, consisting of pouches of posterior stomach wall.

Case V. C. M. This patient had a gastroenterostomy several years previously with continued symptoms. A large pouch was seen on one of the oblique views only about stoma.

Fig. 5*B*. Case VII. Tracing of Figure 5*A*.

Case VI. O. Z. This patient had a gastroenterostomy performed several years previously for "ulcers." The patient continued to have symptoms and complained of abdominal distress which was recurrent. Roentgen examination failed to disclose evidence of ulcers. The stoma functioned, and barium passed through the pylorus. There was considerable spasm about the stoma. A small pouch was seen on the emptying film only.

Case vii. H. W. E. In 1931 the patient had a gastroenterostomy performed for an obstructing ulcer of the duodenum. He had complete relief of gastrointestinal symptoms until recently when he complained of weakness, being "shaky," dizziness, and malaise. He had a

Fig. 5*C*. Case vii. Shows pouches in different view.

complicating cardiac condition. Roentgen examination disclosed a good functioning enterostomy stoma with marked pouch formation about the stoma and jejunum. Two pouches formed on the anterior and posterior side of the jejunum with a protrusion of the posterior wall of the stomach (Fig. 5, *A–D*).

COMMENT

Pouch formation, either "local" or pouches consisting of large segments of the stomach, should be searched for following gastroenterostomy in various positions including the recumbent and standing positions, especially if no cause can be found for the continued presence of symptoms. This is especially true in those cases of a poorly functioning gastroenterostomy stoma for which no cause can be found.

Diligent search and frequent examination may be necessary as the pouches are not seen at all examinations and their appearances vary.

The formation of pouches may be due to several factors. Spasm about the stomal site forming pouches similar to that of an

Fig. 5*D*. Case vii. Tracing of Figure 5*C*.

"hour-glass" stomach (see Fig. 4). Local outpocketings surrounding the stoma: These may be in effect local small peristaltic waves (see Fig. 1, 2, and 3). Local outpocketing due to the effect of the weight and pull of the jejunal loop on the stomach wall (Fig. 5).

CONCLUSIONS

1. Pouch formation occurs after gastroenterostomy, and may be an important factor in its poor functioning.

2. The relationship of pouch formation to stomal ulcers remains to be determined. An etiological factor, however, is suggested; that is, stasis and prolonged action of a gastric juice of high acidity about the stoma in the pouches may be a factor in the formation of stomal ulceration.

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THE ROENTGEN SIGNS OF GASTRITIS*

By L. WALK

IN TWO previous papers[10] I reported my investigations which resulted in a new classification of gastritis. Based on this classification I have revised the various roentgen signs which revision is now presented in the following article. The former state of the roentgen diagnosis of gastritis is seen from the publications of Ansprenger and Kirklin,[1] Schloss, Ettinger and Pratt,[8] Templeton and Schindler,[9] Schinz, Baensch and Friedl,[7] Kelley, Lawlah and Berry,[4] Renshaw,[5] and Berridge.[2]

The following essential points in my classification of gastritis differ from the former literature: The gastroscopic term "hypertrophic gastritis" is no longer used and cases previously included in this group are classified as état mamelonné or as superficial gastritis. État mamelonné is gastroscopically characterized by prominent gastric areolae resembling street pavement, and by translucent superficial epithelium; almost invariably free acid is found in those cases. État mamelonné is more frequently found in duodenal than in gastric ulcer; even if no ulcer is found, état mamelonné is frequently associated with ulcer-like clinical symptoms. Cases with reddened mucosa and with non-translucent epithelium (with or without thickened mucosal folds and prominent areolae) are classified in the group of superficial gastritis; the gastroscopic appearance as well as the clinical symptoms in this group are polymorphous. The term atrophic gastritis is gastroscopically used only if the picture of mucosal atrophy is associated with signs of superficial gastritis.

The exact diagnosis of gastritis is made only gastroscopically. Although sometimes a case can also be detected roentgenologically, this diagnosis should not be made in the roentgen department. Every report of the roentgenologist, however, should contain an exact description of signs which afterwards can be evaluated together with clinical findings. Usually I have recorded: (1) general configuration and tonus of the stomach; (2) intermediary liquid (fluid content of the fasting stomach), hypersecretion, and adherence of the barium to the mucosal surface; (3) caliber and configuration of the mucosal folds (separate notes concerning the antrum and the corpus), turgor of the mucosa; (4) regurgitation of duodenal contents into the stomach. Careful screen work is necessary. If roentgenograms (aimed exposures) are also made, it is often possible to record even the average diameter of the gastric areolae. All this can be recorded briefly, in a few words.

The first small quantity of barium for relief study is given during (not before) roentgenoscopy; manual palpation. The examination should be begun with the patient standing and not lying, as the standing position during the first minutes of the examination makes it possible to see the intermediary liquid, the secretion, and the adherence of the barium to the mucosal surface. Examination in the horizontal position, however, can be performed later.

Mucosal Atrophy. The roentgen appearance of mucosal atrophy varies considerably. There are several histological possibilities in the antrum as in the corpus gland area, giving rise to combinations; e.g. in pernicious anemia only the corpus glands are atrophic. It is therefore not to be expected to find a simple roentgenological appearance covering all those forms. Only a few cases have the typical appearance of a "dry stomach" (no intermediary liquid, absence of roentgenologically visible secretion, and good adherence of the barium to the mucosal surface) with relatively thin folds. The roentgenologist should no more than record the findings. The possibility of

* From the I. Medical Clinic of the University of Tartu.

individual variations in the thickness of the mucosal folds is to be considered. In patients with a long, vertical stomach normally the folds appear relatively thin; on the other hand, a horizontal stomach normally has relatively thick folds. In cases of irritated, tortuous folds those appear relatively thicker than they really are and may cause diagnostic errors. Functional alterations of the folds may occur, especially in the antrum. As this suggests, the roentgenologic differential diagnosis of mucosal atrophy may be difficult.

Superficial gastritis cannot, as a rule, be diagnosed roentgenologically. One may see the usual picture—normal folds, no hypersecretion, good or even remarkably good adherence of the contrast medium to the mucosal surface, normal motor function of the stomach. At the same time the gastroscope may show a reddened, markedly hyperemic mucosa with a non-translucent superficial mucous layer; usually no increased secretion is found roentgenologically in reddened, hyperemic mucosa. The diagnosis of superficial gastritis can thus be secured by means of gastroscopy only. Mucosal swelling, however, can sometimes be detected roentgenologically. Those cases have relatively thick folds; secretion, intermediary liquid and adherence of the barium show no characteristic features. If thickened folds are found roentgenologically in the corpus gland area, there are three possibilities to be considered: swelling of the mucosa, état mamelonné, and as a rarity diffuse sarcoma of the gastric wall (Walk[11]). Careful roentgenoscopy sometimes enables one to differentiate them roentgenologically, the turgor of the swollen mucosa being relatively low as compared with most cases of état mamelonné and especially with diffuse sarcoma. In swollen mucosa the folds are usually relatively low, with only narrow interspaces; on the other hand, in most cases of état mamelonné high folds with broader interspaces are found. Thickened mucosal folds have also been described in leukemia (Rigler[6]) and in lymphogranulomatosis (Jungmann[3]).

Sometimes free mucous masses are demonstrated at roentgenoscopy. In most cases, it is sputum or saliva and its demonstration seems to be of no diagnostic value. Flocculence of the barium also seems to have no diagnostic value. In cases with low fasting acidity (but not in high fasting acidity) regurgitation of duodenal juice into the stomach causes a gastroscopic picture resembling superficial gastritis; further experience, however, is needed in the evaluation of regurgitation as it is seen roentgenologically.

État Mamelonné. Although the gastric areolae can be visualized by means of spot roentgenograms, the état mamelonné cannot be diagnosed roentgenologically, as in normal cases the areolae can also be demonstrated and cannot be differentiated from those in état mamelonné. Only a few cases of état mamelonné have thickened folds roentgenologically; usually the folds appear normal and the turgor of the mucosa is a relatively high one. Hypersecretion is frequently found, sometimes together with intermediary liquid; in these cases the barium usually adheres only slightly to the mucosal surface. The same, however, can be found in normal cases also, especially in patients who have smoked on the morning before coming to the roentgen department. In a stomach with état mamelonné or with normal mucosa the barium, as a rule, cannot be easily mixed with the intermediary liquid (if the latter is present) by palpation, and the secretion usually produces a sharply demarcated layer. In contradistinction to this, in mucosal atrophy the intermediary liquid, if any, is usually easily mixed with the contrast medium. In cases of high intermediary liquid, e.g. in pyloric obstruction, this may be of diagnostic importance. In patients who have drunk water before the examination, intermediary liquid is found which can usually be easily mixed with the barium.

SUMMARY

Although gastritis cannot usually be

diagnosed roentgenologically, there are characteristic roentgenoscopic features which can be evaluated diagnostically together with clinical findings. The roentgen signs of mucosal atrophy, superficial gastritis and état mamelonné are described.

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GASTRIC RETENTION AND GASTRIC ULCER

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THE association of gastric retention with gastric ulcer of the lesser curvature has often been the subject of comment in the literature. Various opinions have been expressed, however, as to the interrelationship of these two conditions.

In 1917 Carman[3] reported 2 patients in whom gastric retention occurred with gastric ulcer. This was incorporated in a presentation of combined gastric and duodenal ulcers.

Emery and Monroe[4] in 1931 demonstrated gastric retention in 50 per cent of cases of gastric ulcer.

In 1932 Stone and Ruggles[15] stated that "In some cases of gastric ulcer . . . . that show no improvement in gastric symptoms after operation, the cause is to be sought in a hypertrophied pylorus which has resulted from a long-continued reflex pylorospasm." A case demonstrating this point is presented and illustrated. At operation a hypertrophied pylorus was found and the condition remedied by Fredet-Rammstedt operation.

Bull[2] in 1935 believed that the delayed emptying time noted in about 25 per cent of cases of gastric ulcers on the upper two-thirds of the lesser curvature was probably due to an inhibition of peristalsis since it may be present in the absence of demonstrable pyloric spasm.

In 1937 a different concept was advanced by Golden.[9] He suggested that the available evidence indicated that the prepyloric narrowing sometimes seen with gastric ulcer of the lesser curvature was on an inflammatory basis and was directly responsible for physiological and anatomical changes observed with the possible exception of the penetrating ulcer.

Feldman[6] in 1938 stated that gastric retention in cases of gastric ulceration was usually due to pylorospasm.

Also in 1938 Shanks, Kerley and Twining[14] quoted Hurst concerning the relationship between rate of gastric emptying and gastric ulcer as follows:

(1) gastric ulcer with normal pyloric function;

(2) gastric ulcer with pyloric achalasia (a reflex inhibition of relaxation resulting from a remote abdominal lesion such as an appendicular or biliary focus of irritation);

(3) gastric ulcer with pylorospasm, simulating pyloric obstruction in the early stages of the examination and later relaxing to allow the stomach to empty;

(4) gastric ulcer with pyloric obstruction in which the pylorus fails to open normally at all.

Buckstein[1] in 1940 wrote that when the gastric ulcer is at some distance from the pylorus the cause of pathologic gastric retention is not easily explained. While pylorospasm might be present, perhaps a disturbance in the gastric gradient was suggested as an important associated factor.

In 1941 Golden[10] stated that a small or moderate six hour retention is seen in about half the cases of gastric ulcer even when the crater is located relatively high. He went on to say that this retention is usually due to the interference of the ulcer with gastric motility, not to pyloric obstruction. It was also mentioned that the hypertrophy of the pyloric muscle occasionally encountered in adults, not infrequently in conjunction with gastric ulcer, was undoubtedly responsible for symptoms in some cases.

Templeton[16] comprehensively discussed the situation in 1944 from the double vantage point of gastroscopy and roentgenology. He stated that the frequent association of benign narrowing of the antrum

with ulceration along the vertical portion of the stomach has been recognized. So frequent is the association that it is imperative in his opinion to search the rest of the stomach carefully for ulcer whenever benign narrowing of the antrum is noted. He was impressed by the fact that this narrowing persists after the ulcer has healed under medical treatment which is a point against its reflex spastic origin. That the antral narrowing is not a "roentgenologic anomaly" is attested by the retention from which all the patients in his series suffered. He thought that the obstruction caused by the hypertrophy might give rise to the ulceration, but a definite relationship was not found in 20 cases studied by both gastroscopy and roentgen ray. He also stated that there was reason to believe that this antral narrowing may be caused by local inflammation in view of the work of the pathologists Serck-Hanssen,[13] Faber,[5] and Konjetzny.[12] A case is presented in which after four years of observation with intermittence of the lesser curvature ulcer, operation disclosed a narrowed antral canal with a shallow ulcer crater there and inflamed mucosa.

In 1945[7] and also in 1946[8] Feldman reiterated his previous belief that pylorospasm is nearly always observed in active cases of gastric ulcer and is usually responsible for the gastric retention.

Incidentally there were several illustrations scattered throughout the above literature which demonstrated lesser curvature ulcer, gastric dilatation and scarred duodenum without comment as to relationship.

This incomplete review of the subject reveals that at least three different mechanisms have been advanced to explain retention when seen with gastric ulcer: (1) pylorospasm; (2) interference with gastric motility as typified by the terms "achalasia," "inhibition of peristalsis," and "disturbed gastric gradient"; (3) organic obstruction due either to cicatricial stenosis, benign hypertrophy of the pylorus, or antral gastritis.

Possibly the wide diversity of opinion as to the findings at the pylorus is partially due to lack of definitive methods of study especially in the earlier reports. By this is meant, specifically, the use of aimed and regulated compression to bring out mucosal detail with a moving or fixed grid. Then various organic and functional conditions can usually be differentiated. A simple method of accomplishing this end has been reported by one of the authors of this paper.[11]

In this paper evidence is presented to show that in some patients with the complex under discussion, obstruction is produced by scarring from a duodenal or pyloric ulcer and that the lesser curvature ulcer develops after the gastric retention. The 2 cases which first directed our attention to this sequence of events are presented below. In both, repeated examinations had established the steps in the development of the two conditions. At the time of the original examinations, both patients had peptic ulceration in the duodenum near the pylorus and in neither was any gastric lesion present. Subsequent study showed the development of stenosis and gastric retention. With this, widening of the rugal folds throughout the entire stomach appeared, producing the picture of so-called hypertrophic gastritis. Both of these patients then developed ulceration of the lesser curvature.

REPORT OF CASES

Case 1. R.N., aged thirty-nine, American housewife. Admitted to the hospital on March 12, 1938, with history of sudden onset of severe epigastric pain twelve hours before admission. Patient stated that she had been having epigastric distress almost continuously for a period of eight years. Pain would come on one to two hours after meals, relieved by food and soda bicarbonate. Physical examination showed board-like rigidity and extreme tenderness over entire abdomen. A diagnosis of a perforated peptic ulcer was made and immediate operation performed. The peritoneal cavity contained free exudate. A perforation was found in the duodenum. Adhesions were present between

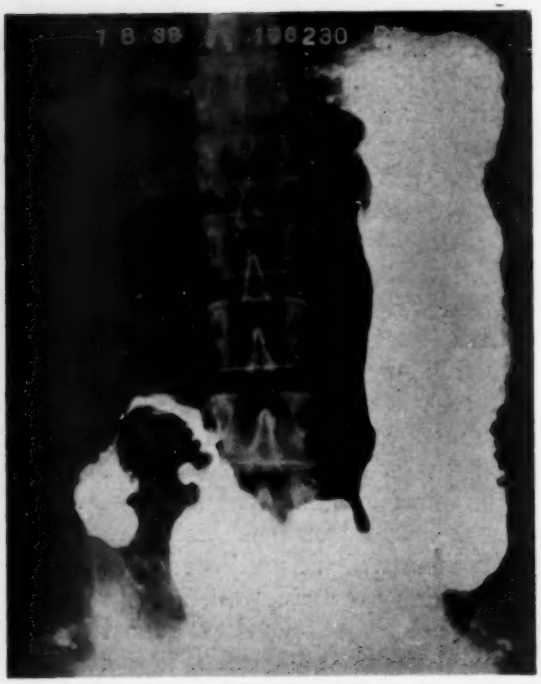

FIG. 1. Case I. 1938. Showing deformity due to duodenal ulcer.

the duodenum and the under surface of the liver. The perforation was sutured and the abdomen closed without drainage. Recovery was uneventful. Roentgenographic examination on April 4, 1938 (Fig. 1), showed deformity of duodenum and slight six hour retention. There was no evidence of a gastric lesion.

Patient was followed in the out-patient department. Her condition remained fair. She had some epigastric pain and complained of splashing and discomfort in epigastrium. Physical examination showed a dilated stomach with some visible peristalsis. Refused admission for operation. Had three courses of larostidin injections.

On November 16, 1940 patient vomited large quantities of blood and had black stools.

FIG. 2. Case I. 1941. Three years later. Shows duodenal deformity still present. Also large ulcer of stomach.

FIG. 3. Case I. 1941. Six hour roentgenogram showing large gastric residue.

She was in bed at home for seven weeks; had a second gastric hemorrhage on January 23, 1941. Admitted to the hospital on January 27, 1941.

Roentgenographic examination on January 29, 1941, showed evidence of pyloric stenosis and of a new large ulceration on the lesser curvature (Fig. 2). A large amount of barium was retained in the stomach after six hour examination (Fig. 3). Roentgen findings confirmed at operation. Gastric resection and gastroenterostomy performed. Patient was symptom free, for the first time in eight years.

CASE II. E.S., male, aged forty-two, Swedish

janitor. First examination on May 24, 1937. He presented a history of having been roentgenographed in Sweden in 1933 with resulting diagnosis of peptic ulcer. He had been well on a restricted diet until four months before examination, when recurrence of symptoms had been induced by dietary indiscretion. Roentgenograms showed deformity of pylorus and duodenal cap indicating ulceration at or near the pylorus (Fig. 4).

Patient was placed on ulcer regimen and continued to have some epigastric pain. He was

Fig. 4. Case II. 1937. Deformity of duodenum due to ulcer.

followed in the hospital and in the out-patient department but surgical intervention was not urged due to the fact that the patient had been found to have a luetic aortitis.

Symptoms continued with some increase in severity toward end of 1940. Readmitted to the hospital on January 10, 1941.

Roentgenographic examination on February 3, 1941, showed large ulcer crater in the mid lesser curvature (Fig. 5) and at six hours a large gastric residue was present, indicating pyloric obstruction (Fig. 6). These findings were subsequently confirmed at operation.

This presentation does not imply that the majority of cases of gastric ulcer are

Fig. 5. Case II. 1941. Four years later. Shows duodenal deformity and large ulcer of the lesser curvature.

secondary to gastric retention. In our experience most lesser curvature gastric ulcers

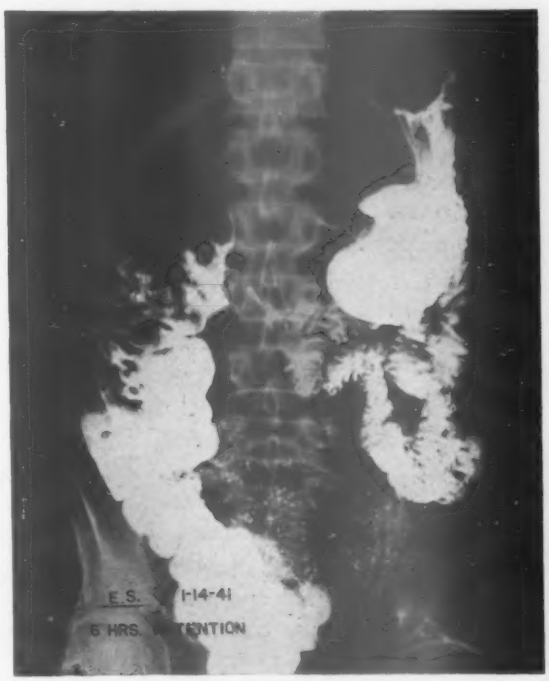

Fig. 6. Case II. 1941. Six hour roentgenogram shows gastric retention.

FIG. 7. Case III. Roentgenogram shows contraction of lesser curvature with pylorus drawn up to the base of the ulceration on the lesser curvature.

FIG. 8. Case II. Six hour roentgenogram shows retention in the stomach and demonstrates the involvement of the pylorus by the induration at the lower margin of the ulcer.

show no evidence of pyloric obstruction and no retention on the six hour roentgenogram.

To round out the picture a different condition is presented in which gastric ulcer and gastric retention are associated, as illustrated by the following case report. Here a large ulcer on the lesser curvature was present in which the inflammatory and cicatricial changes had extended some distance to the pylorus which became stenotic due to direct involvement. The roentgenographic appearance in this condition has variously been termed "purse-string stomach," "Beutelmagen," "snail-like retraction," and "schneckenformige Einrollung," "rolling in of antrum," and other equivalents in different languages.

CASE III. C.R., aged forty-six, American housewife. On admission the patient complained of pain in epigastrium off and on for a period of six months. She had lost 5 pounds in weight. No abdominal operations. Roentgenographic examination in this case showed a large ulcer crater on the lower lesser curvature (Fig. 7). It will be noted that the induration and scarring about the ulceration extends to and involves the pylorus. The entire lower lesser curvature has been shortened due to cicatrization producing a pouch stomach. Figure 8 shows the large gastric residue at six hours. The ulcer crater and its surrounding induration are well demonstrated.

COMMENT

Our own material was originally assembled in 1941. During the war years the project was interrupted. In 1946, however, sufficient examples of the end stage of the condition were observed to indicate that it occurs fairly frequently. The practical point to be gleaned from this report is that response to treatment of the gastric ulcer in this complex is materially dependent upon the alleviation of the gastric retention by medical or surgical measures.

CONCLUSION

Gastric retention due to organic obstruction at or near the pylorus often precedes

and may have a causal relationship to the subsequent development of gastric ulcer of the lesser curvature.

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GALLSTONE ILEUS ASSOCIATED WITH DIVERTICULITIS OF THE COLON

A CASE REPORT

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THE following case of intestinal obstruction due to a gallstone is presented because of several unusual and interesting features. Among these were the occurrence of the impaction in a region of the sigmoid concomitantly involved by diverticulitis, and the recovery of the patient under conservative treatment. We wish to re-emphasize the importance of including gallstone ileus in the differential diagnosis of intestinal obstruction, especially in an elderly female with an antecedent history of gallbladder disease.

CASE REPORT

M.D., a housewife, aged seventy-two, was admitted to this hospital for the first time on March 1, 1946 with a seven day history of progressively increasing nausea, vomiting, and colicky abdominal pain. The pain had its onset in the epigastrium and then radiated to the left para-umbilical region and the left lower quadrant. During the two days prior to hospitalization there were abdominal distention and obstipation.

The medical history revealed that in the past ten years there had been two acute episodes of what had been regarded by her private physician as "gallbladder attacks." In roentgenograms made five months prior to her present illness, the gallbladder failed to visualize after administration of oral dye. No opaque calculi were apparent in the right upper quadrant of the abdomen at that time. Four years previously she had had a hysterectomy for uterine

FIG. 1. Roentgenogram of abdomen, in upright position showing marked dilatation of loops of large and small intestine and the presence of fluid levels. (Date should be 3-2-46, not 3-4-26.)

FIG. 2. Roentgenogram of the abdomen, in the horizontal position, showing marked dilatation of loops of large and small intestine.

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FIG. 3. Barium enema done on the fourth hospital day. Note presence of a diverticulum in proximal sigmoid, associated with narrowing of the lumen at this point (lower arrow). Area of decreased density in transverse colon (upper arrow) represents gallstone dislodged by the influx of the enema.

FIG. 4. Post-evacuation roentgenogram showing area of decreased density at junction of sigmoid and descending colon, with narrowing of sigmoid just distal to it (arrow). Area of decreased density has the size and shape of the gallstone passed spontaneously (Fig. 5).

myomas. She had been troubled with moderate constipation for many years.

Physical examination upon admission revealed a moderately obese, acutely ill elderly female, who appeared somewhat dehydrated. The temperature was 99.8°F., pulse 96, respirations 22, and the blood pressure 146/70. The heart and lungs were essentially normal. There was a moderate degree of abdominal distention with some tenderness in the epigastrium and right upper quadrant. No masses could be palpated either abdominally or rectally.

The laboratory findings were: urine, negative; leukocyte count, 6,900 with a normal differential count; erythrocyte count, 3,900,000; hemoglobin, 12 grams.

Roentgenograms of the abdomen, made on the second day of hospitalization, in the upright (Fig. 1) and horizontal (Fig. 2) positions revealed marked dilatation of loops of small and large intestine with the presence of fluid levels. The impression was that a mechanical intestinal obstruction existed with the site of obstruction in the distal colon.

Under supportive therapy, with repeated enemas, the patient's condition slowly improved and she began to evacuate spontaneously small stools which were occasionally blood streaked.

On the fourth hospital day the colon was examined by means of an opaque enema (Fig. 3 and 4). The roentgenograms demonstrated the presence of a diverticulum in the proximal portion of the sigmoid, which was associated with a considerable amount of narrowing of the colon in this region. Just proximal to this constriction there was noted a negative shadow within the barium-filled colon which was regarded as feces. The narrowing was thought to be due to either a neoplastic or inflammatory process, and reexamination at a later date was recommended.

The patient continued to do well, and on the fourteenth hospital day the barium enema was repeated, with findings similar to those of the preceding examination, except that at this time the lumen of the constricted segment of the sigmoid was somewhat wider. It was felt, therefore, that the second examination favored the diagnosis of diverticulitis rather than neoplasm. It was decided that the patient be

treated with mineral oil and antispasmodics for about two weeks before another study of the colon was made.

Eighteen days after admission the patient was discharged with the diagnoses of (1) subacute intestinal obstruction, improved, (2) diverticulitis of the sigmoid, and (3) possible neoplasm of the sigmoid. Her course at home proved to be uneventful until the seventh day, when she passed a hard dark object during a bowel movement. Upon examination, which included laboratory analysis, this object proved

FIG. 5. Roentgenogram of gallstone passed by patient Compare with Figure 4.

to be a gallstone (Fig. 5), which measured 2.5 by 3.5 cm. Unfortunately the actual site of the fistula between the gallbladder and intestinal tract was not demonstrated on our roentgenograms, and the patient refused to return for further roentgen studies.

DISCUSSION

Because the incidence of gallstone ileus is low, the possibility of its presence is more often than not disregarded in any one individual instance of intestinal obstruction. Various authors gave the incidence of intestinal obstruction due to gallstones as ranging from 0.4 per cent to 5 per cent of all cases of bowel obstruction.[6] The importance of the early diagnosis of this condition is to be emphasized, for without timely surgical intervention the average mortality rate is about 50 per cent.

It is uncommon for the site of impaction of a gallstone to be in the large bowel. In a review of 150 cases of gallstone ileus, Foss and Summers[3] found that in 125 cases (83 per cent) the stone lodged in the ileum. In 88 of these cases (59 per cent of the total number), the site of obstruction was the terminal ileum, and in only 5 cases (3.3 per cent) was the obstruction encountered in the colon or rectum. It is interesting to note that in his discussion of the above paper, Dr. E. Vernon Mastin reports a case of his own somewhat similar to the one herein presented. In his case a large gallstone became impacted in a diverticulum of the rectosigmoid region where there was also an associated stricture of the bowel.

It is felt that in the present case the gallstone would have passed spontaneously had it not encountered the spastic narrowing of the sigmoid at the site of the diverticulum. Later, when the spasm was relieved, the gallstone was passed.

While it is generally admitted that the recognition of gallstone ileus preoperatively is very infrequent, even with the aid of appropriate roentgenograms, in retrospect we feel the diagnosis might have been made in our case. In Figure 4 (post-evacuation), a negative shadow, which corresponds closely in size and shape to the gallstone later recovered by the patient, is seen just proximal to the stricture in the sigmoid. Evidently, during the administration of the barium enema, the stone was temporarily dislodged, for on one roentgenogram (Fig. 3) it can be seen in the transverse colon. The demonstration that the stone was not permanently lodged in the sigmoid, and the fact that the obstruction was partially relieved by the enemas which the patient received undoubtedly explain why, in the course of treatment, the intestinal obstruction was neither complete nor persistent.

SUMMARY

1. A case of intestinal obstruction due to a large gallstone in the sigmoid, associated with diverticulitis of the sigmoid, is presented.

2. The interesting features of the case

are discussed and some references made to the literature.

3. Emphasis is placed on the importance of considering gallstone impaction in the differential diagnosis of intestinal obstruction, especially in elderly females who give a history of gallbladder disease.

Appreciation is extended to Dr. Louis Greenwald of New York City for his kind permission to report this case.

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SUGGESTED OUTLINE FOR THE TRAINING OF RADIOLOGISTS AT QUALIFIED UNITED STATES NAVAL HOSPITALS*†

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PREFACE

At the request of the Head of the Training Branch, Bureau of Medicine and Surgery, Navy Department, I was asked to prepare an outline for the training of naval medical officers in radiology that would lead to their certification by the American Board of Radiology. In attempting to do this, it soon became apparent that very few articles had been written on this subject, and actually, few references were available.

In formulating this outline the counsel of radiologists who had served in the Navy was sought and used to make this a working basis for general use in the naval hospitals. During this survey considerable interest was expressed by various physicians who were preparing similar programs of postgraduate training for the Army Medical Corps, for the Veterans Administration, and for the United States Public Health Service. Because of the widespread interest, it was felt that the publication of this outline might be helpful to those who were charged with similar responsibilities and at a time when considerable discussion is still going on with respect to postgraduate training in radiology. It should be emphasized that this outline serves only as a basis for a working program. An effort was made to simulate as nearly as possible the type of training that is being carried on in qualified civilian hospitals over the country.

INTRODUCTION

ANY program for the training of naval medical officers in radiology must necessarily be directed toward fulfilling the requirements established by the American Board of Radiology. The program as outlined below is intended to fulfill these requirements and, in addition, to do so in a manner that is practical within the organization and setup of the Medical Department of the United States Navy.

It is highly desirable that such a training program should be carried out uniformly in all the naval hospitals as regards subject matter and the chronological order and sequence in which it is given. In doing so, it makes it feasible for a medical officer to embark on a three-year period of training in radiology and still be available for transfer, although such transfers should be avoided if at all possible during said training period. At the same time, it is recognized that administrative problems and the physical setup of the individual departments in the various hospitals vary and that the proposed schedule of training must be adapted to meet the local conditions. Yet the aim should always be toward the development of a uniform program in the naval hospital designated for training in radiology.

The suggested hours and time allotted for the various divisions of radiology are recommendations. In adding up the total hours arranged per day, the total may exceed eight hours, but several of the assignments are overlapping and can be carried on simultaneously.

It is imperative at all times that a radiologist certified by the American Board of Radiology be in charge of the departments at the naval hospitals designated for training in radiology.

Definitions. The medical specialty of radiology includes the divisions listed below, and the American Board of Radiology can certify a medical officer in any of these

* From the Edward Mallinckrodt Institute of Radiology, Washington University School of Medicine, St. Louis, Missouri.
† The opinions or assertions contained herein are the private ones of the writer and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large.
‡ Reserve Consultant in Radiology to the Bureau of Medicine and Surgery, Navy Department.

branches. This training program is directed toward qualifying medical officers in Radiology or Roentgenology, as it is felt that medical officers certified in these divisions will be more competent to handle the work that is required of radiologists in the larger naval hospitals. The following definitions were taken from the booklet. "The American Board of Radiology," 1946:

1. *Radiology* is that branch of medicine which deals with the diagnostic and therapeutic application of radiant energy, including roentgen rays and radium.
2. *Roentgenology* is that branch of Radiology which deals with diagnostic and therapeutic application of roentgen rays.
3. *Diagnostic Roentgenology* is that branch of Radiology which deals with the diagnostic application of roentgen rays.
4. *Therapeutic Radiology* is that branch of Radiology which deals with the therapeutic application of roentgen rays and radium.

General Requirements. Each applicant, for admission to the examination, is required to present evidence that he has met certain general standards which are already required of naval medical officers.

An applicant must also be a graduate of a medical school recognized by the Council on Medical Education and Hospitals of the American Medical Association.

It is also necessary that applicants must have completed an internship of not less than one year in a hospital approved by the same Council.

The American Board of Radiology further requires that after completion of the internship all applicants must receive a "period of special training in radiology of not less than three years in clinics, hospitals, and dispensaries recognized and approved by the American Board of Radiology and the Council on Medical Education and Hospitals of the American Medical Association as competent to provide a satisfactory training in radiology." This period of specialized training shall include:

(a) Graduate training in pathology, radiation physics, and radiobiology.

A period of six months' full-time training in pathologic anatomy is recommended, but where this is not possible to arrange the student during his three-year training period may, by attending pathologic conferences, postmortem examinations, and studying removed tissues, receive adequate training in pathology. It is recommended that radiation physics be taught by a combination of didactic lectures, practical examples, and direct clinical demonstrations.

(b) An active residency of not less than 24 months in a recognized and approved radiological department by the above organizations.

(c) The examination includes the basic sciences of Radiology as well as the clinical aspects thereof.

OUTLINE FOR THREE-YEAR TRAINING PERIOD IN RADIOLOGY

The working period is based on eleven months' active work each year, with the twelfth month being allotted for a vacation period. Each day's work is based on a seven and a half hour working period, exclusive of time required for lunch, and is based on a five and a half day week.

1. *Continuous Courses During the Three-Year Period.*

   (a) In naval hospitals, as in most civilian hospitals, it is impractical to spend a six months' full-time training period in pathology. Consequently, to fill the requirements of the Board, it is essential that the student:

      1. Attend the clinical-pathological conferences conducted by the department of pathology.
      2. Attend the postmortem examinations conducted in the hospital.
      3. Make rounds with the staffs of the orthopedic and chest services at least once a week in order to be familiar with the clinical demands of these services and to aid them in their diagnostic and treatment problems.
      4. Develop a personal contact with members of the department of pathology who will instruct him in the gross and microscopic examination of tissues removed at operations, biopsies,

and autopsies. Such training will not only aid the student in the interpretation of the pathologic processes as recorded on the roentgenogram, but will make him more familiar with tumor tissue.

(b) A monthly pathologic-radiologic conference should be held jointly by the two departments, at which the gross and microscopic specimens obtained from operations, biopsies, and autopsies are available. Roentgenograms and roentgenographic examinations made on these cases should be demonstrated and the roentgen diagnosis discussed, after which the pathologic material is presented and compared with the roentgen findings.

(c) It should be mandatory for the medical officers undergoing training in Radiology to attend the meetings and clinics conducted by the Tumor Board at their respective hospitals.

(d) Throughout the training period all trainees should attend the meetings of the local radiological society as well as those conducted by the radiological departments at the neighboring medical schools.

2. *Program for First Year: (Intern in Radiology).*

(a) Instruction in dark-room and film processing techniques:

($\frac{1}{2}$ day for 4 weeks)

A thorough understanding and familiarity with film processing techniques is essential for naval radiologists who may be called upon to set up dark rooms in far-away places under difficult circumstances and possibly without trained technical assistance. Trainees should become familiar with the preparation of the developing and fixing solutions, with the proper storage of films; and with the mechanical means of maintaining the chemical solutions at the proper temperature.

(b) Instruction in roentgenographic technique and procedures:

($\frac{1}{2}$ day for 10 months)

Only from experience gained in positioning the patients and in the actual taking of the roentgenograms can the trainee achieve confidence and a feeling of security in doing roentgenography. It is not the purpose to have him serve as a technician, but rather to have him share in the responsibility for the production of the general roentgenographic work during the first year. Only by actually operating the machines will he become familiar with them and learn their capacities and limitations. He should also assist in the more advanced diagnostic roentgenographic procedures during this period. This includes experience in the operation of mobile diagnostic equipment. The importance of good technical work and the radiologist's ability to perform it cannot be overstressed.

(c) Instruction on film interpretation:

(Approximately 2 hours daily for 11 months)

Trainees should attend the film reading sessions and after a few weeks should be assigned a certain group of roentgenograms for interpretation and the preparation of the report. This, of course is done under supervision and is checked by the radiologist.

(d) Instruction in office procedures, in the film filing system, and in the maintenance of the pathologic cross-file of roentgen reports:

During this first year, the trainee should be instructed in the film filing system and in the maintenance of the pathologic cross-file of roentgen reports. The latter is important because every naval hospital must maintain such a cross-file. It is one of the requirements for certification for residency training in radiology by the American Medical Association.

(e) Lecture course and demonstrations in radiation physics:

(Minimum of 16 one-hour lectures and demonstrations)

This course can be conducted in one of three ways:

(A) By having the local Consultant in Radiology arrange for the trainees to attend the course on Radiation Physics that is given in the department of radiology at a nearby medical school.

(B) By having the Chief of the Department of Radiology at the naval hospital hold a seminar each week for the trainees and systematically

going through each chapter in one of the standard textbooks on this subject.

(C) A third and perhaps the best method of conducting a course in radiation physics is one suggested by Dr. John D. Camp, Chairman of the Commission on Education of the American College of Radiology. He has suggested that the Bureau of Medicine and Surgery could assemble the necessary naval and civilian instructors for this course at some central hospital (Brooklyn or Bethesda) and order their residents in radiology for temporary duty for such a course of whatever duration would seem indicated. Since the training program is of a three-year period, only the third-year men would be in attendance at the same time, and in this way, the instruction course could be carried on without handicapping the routine clinical work in the department. Such a course would provide a more uniform basis of instruction given by the best specialists in this field. This course could be considered as a final and graduate review of radiation physics and would necessarily be amplified by local instruction as indicated above in "A" and "B."

3. *Program for Second Year: (Assistant Resident in Radiology).*

(a) Instruction in diagnostic roentgenology of the gastrointestinal tract.

(Each morning for 11 months)

With the background of basic training gained during the first year, the trainee should now be allowed to concentrate a large part of his energies in perfecting his skill and knowledge of gastrointestinal roentgenology. This field is one of the most difficult to master but one of the most important. Gastrointestinal examinations form a large part of the work done in the radiological departments of naval hospitals and must be done with a high degree of accuracy, as results can greatly influence the career of military personnel.

(b) Instruction in roentgenological examination of the urinary tract.

(To be worked in with morning gastrointestinal examinations. Intravenous urological examinations may be scheduled for convenient times)

Throughout the year the trainee should conduct the intravenous urographic examinations under the supervision of the radiologist. Instruction should include indications, contraindications, precautions to be exercised in this examination, and the technique of injection. The trainee should make the preliminary interpretation of the films and prepare the final report after consultation with the radiologist. When practical, the trainee should be present during most of the retrograde urographic examinations to become familiar with this procedure as well as cystograms and urethrograms.

(c) Instruction in special roentgenographic procedures.

(As scheduled in the Department of Radiology)

It is realized that instruction and mastery of the following roentgenographic procedures cannot be confined to just the second year. This work, obviously, must be started in the first year and developed throughout the three-year period; but special effort should be made to see that the trainee becomes familiar with these various techniques and thoroughly understands them. It is probable that instruction in several of the techniques can be gained only in civilian hospitals, and it is one of the duties of the Consultants in Radiology to see that the trainees in the naval hospitals obtain instructions in these methods:

1. Spinal myelography
2. Pneumoencephalography and pneumoventriculography
3. Bronchography
4. Body section roentgenography
5. Roentgen kymography of the heart
6. Visualization of the heart and great vessels by the use of contrast media
7. Catheterization of the heart and venous system (in certain institutions, only)
8. Exploration of sinus tracts and fistulae with opaque materials

(d) Film interpretation.

(Approximately 2 hours daily for 11 months)

During the second year the trainee should be given more responsibility both in quantity and in the range of roentgenograms for interpretation. This should still be guided and supervised.

(e) Introduction to superficial and deep roentgen therapy and radium therapy.

(Approximately one hour daily for 11 months)

Beginning the second year, the trainee should be introduced to superficial and deep roentgen therapy by attendance for at least one hour during the routine period of superficial and deep roentgen therapy as well as an opportunity of observing what radium therapy may be carried on at that particular hospital. During this period he should examine the patients undergoing treatment with the radiologist, observe their response to treatment, and see them at the follow-up examination. He should also become familiar with the operation of the therapy machines and the standard techniques that are used. He can profit by reading the standard reference books on radiation therapy.

4. *Program for Third Year: (Resident in Radiology).*

(Approximately 2 hours daily for 11 months)

During the third year the trainee should be considered as Resident in Radiology and, consequently, should be given considerable responsibility in diagnostic roentgenology and in the general operation of the department. During this year the main effort in teaching should be concentrated on roentgen and radium therapy.

(a) Film interpretation:

(Approximately 2 hours daily for 11 months)

During the third year the trainee should be given considerable responsibility in the interpretation of roentgenograms and in the preparation of the reports. He should also be allowed considerable freedom in directing the activities and assignments of the intern and assistant resident in radiology.

(b) Lecture course and demonstrations in radiation physics:

(Minimum of 16 one-hour lectures and demonstrations)

It is felt that the Resident should repeat this course and, at the same time, should take an active part in the preparation of several of the lectures and demonstrations.

(c) Advanced instruction in superficial and deep roentgen and radium therapy:

(½ day for 11 months)

It is during the third year that the trainee should concentrate on learning radiation therapy because he has grasped the fundamentals of radiation physics and has had one year of limited experience in therapy. He now should see the new patients in consultation with the radiologist, outline the course of treatment, and actually carry out the treatments on a group of patients.

In most instances, the variety and quantity of radiation therapy are somewhat limited in all but a few of the naval hospitals, and for this reason the third year is the most desirable period for the trainee to obtain a year's training in a department of radiology in a civilian hospital. In this way he will have not only greater opportunities to see more patients undergoing radiation treatments, but also an opportunity to observe and participate in the many specialized roentgenographic examinations and procedures that are less frequently done in naval hospitals. These same facts apply to radium therapy. He should see or perform at least ten radium applications for cancer of the cervix uteri.

The trainee must be instructed in the use of radioactive isotopes as used in radiation therapy and have a working knowledge of their application as "tracers." It is further desirable that the trainees as well as the radiologists in the Navy make application for one or more of the various courses that are offered by the Navy Department in the use and hazards of radioactive materials.

(d) Preparation of a manuscript for publication:

The first year the medical officer starts his training in radiology, he should be informed that he is expected to prepare a paper for publication on some subject in radiology, preferably the results of some investigative work. The subject matter and work should be guided and supervised by the radiologist or undertaken with him on a joint basis.

DUTIES OF THE RESERVE CONSULTANTS IN RADIOLOGY ASSIGNED TO NAVAL HOSPITALS

These officers are to act as consultants in developing, strengthening, and promoting the department of radiology in that hospital. They must work closely with the radiologist assigned to the hospital and with the commanding officer.

The success of the resident training program in radiology in naval hospitals is contingent upon finding qualified radiologists who are competent and trained in the teaching of radiology. This is a difficult problem because naval medical officers are not trained in the same manner as radiologists in teaching institutions. Therefore, the real duties of the civilian Consultants will be to supplement this deficiency and bring to the naval hospital the advantages of their teaching experience.

There should be no limit to the number of civilian Consultants in Radiology to any qualified naval hospital. The number should depend on the needs and requirements of that particular naval hospital. Only by the assignment of sufficient Consultants can the teaching program be comparative to that achieved by university departments of radiology.

Specifically, the duties of the Consultants may include such items as the following:

1. Assist in the development and continued maintenance of an acceptable cross-file of the diagnostic roentgen reports.
2. Assist in the training program of the resident staff along the lines outlined in the preceding report, and help in maintaining a continuity of the program during the transfers of the chiefs of the department of radiology.
3. Make arrangements to supplement the teaching of the resident staff to fulfill the requirements of the American Board of Radiology in the courses, clinics, and seminars that are conducted in the radiological departments of the local civilian hospitals and medical schools. The Consultant can be especially helpful in arranging for the resident staff to attend courses in radiation physics, superficial and deep roentgen therapy, radium therapy, and in the clinical-pathological conferences.
4. The Consultant can also be extremely helpful in seeing that the radiological work is conducted and maintained at a high standard of professional efficiency and accuracy. He can also be helpful in an advisory capacity in the selection of equipment and in the maintenance of that equipment. If possible, he should be present at the radiological-pathological conferences and can often supplement them by bringing interesting roentgenograms and pathological specimens from his own collection.

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TRIBUTE TO WILHELM CONRAD RÖNTGEN*

By GONZALO ESGUERRA GOMEZ†
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BOGOTÁ, COLOMBIA, SOUTH AMERICA

WE, the American specialists in roentgenology and curietherapy, have met today for the purpose of paying tribute to the discoverer of the roentgen ray and to recollect the important progress that has been made by this science and the benefits which humanity has derived from it during the fifty years that have elapsed since that historical eighth of November, 1895.

The President of this Congress has decided that a member of the Colombian delegation be selected for paying this tribute tonight to the name and work of Röntgen, and also to record the influence which his discovery has had on 20th century medicine—a grave charge which I have accepted with devotion and pride not with the intention of relating to you the life of Wilhelm Conrad Röntgen or the details of his discovery, or his well known scientific work in the field of physics, because you already know all these better than I do; you have studied them profoundly and your disciples have learned them all from your lips. My only desire is to describe graphically some of the outstanding characteristics of his clearly defined personality as a man and as a scientist, so that they may serve us as a guide and as an example in our every day tasks.

And I also hope that we can find time to meditate for a moment upon the contribution which roentgenology has made to the medicine of our century and upon that which it promises to do in the future in diagnosis and treatment.

On recalling that memorable meeting, held on January 23, 1896, of the Medical-Physical Society of Würzburg, whose fiftieth anniversary we have just celebrated, this question comes to our lips:

Why are the rays which were discovered by Röntgen called today x-rays, when the unanimous and enthusiastic approval given at that time to the proposal of Professor Kölliker was that they be named roentgen rays?

I frequently evoke the details of the meeting held in January, 1896, because, for Röntgen and for the town of Würzburg as well, those were undoubtedly the most exciting hours that followed the unforgettable evening of his discovery. I am thinking of the smallness of the great lecture hall for accommodating the scientists, countrymen and friends of Röntgen who gathered hurriedly to see for themselves the marvellous discovery which, for two months, had moved Europe and America on account of its amazing novelty.

We who have witnessed the birth of the atomic bomb can imagine how Röntgen's rays must have confused and aroused the imagination of the men of that time. Not only was the discovery of the rays not inferior to that of the bomb, but it was created by only one mind, and in search of some ray of hope for relieving humanity of the terrible diseases that afflicted it. What a difference from this other invention, the object of anxiety and anguish due to the destruction it may cause in the future to humanity—our humanity that is so fond of sowing hatred and destruction among those who should be brothers, companions and collaborators!

Silence reigned in the room during that August assembly, when, after Röntgen's simple but glorious explanation, Professor Kölliker went forward to have his hand roentgenographed for the first time, and then that numerous and select audience burst out with a murmur of restrained admiration on seeing the bones of the hand

* Address delivered on Tuesday evening, November 20, 1946, at a Solemn Session in commemoration of the discovery of the roentgen rays, at the Second Inter-American Congress of Radiology held in Havana, Cuba, November 17–22, 1946.

photographed on the plate. And the words with which Professor Kölliker ended his dissertation were nothing but the reflection of a unanimous sentiment of praise and gratitude to him who so modestly gave to the world the result of his discovery—roentgen rays. This is what the whole gathering requested as an immortal name for these radiations.

What happened then, I ask, to prevent the scientific world, fifty years later from continuing to call these radiations roentgen rays? The answer is—the modesty of the discoverer. His inborn modesty led him, in fact, on every occasion on which he presented a communication or gave a conference, to call them x-rays. And as his work was and still is the basis and unyielding foundation of them, he himself succeeded, contrary to the desires of the whole world, in causing his name to be forgotten in connection with the rays which, in spite of their well known characteristics, are at present usually called x-rays.

But furthermore I find that this x, symbol of the unknown, attracted greatly the attention of the whole world, as the marvellous and surprising properties of the rays called for a name capable of conveying to the mind the idea of the unreal and the supernatural. It is believed today that, due to their unknown characteristics, it was natural that Röntgen should call them x-rays. And it is precisely necessary that an explanation be made in this respect. It would be sufficient to read his three original communications in order to be convinced that the discoverer was in no doubt at all about the nature of the rays. He supposed and demonstrated that they had to do with certain radiations having properties similar to those of light; and on applying the "x" he did nothing more than fix, by means of a letter, the name of an unknown radiation when stating the equation, but of an equivalent well known to him when solving it. Let us listen to his own words.

> There must be some relation between the new radiations or Rays and the radiations or rays of the sun. At least this is indicated by the formation of shadows, the fluorescent properties, and the chemical effects which are common to both radiations.

To Röntgen, those radiations were, from that time, what they are now: a form of light.

Röntgen's name still prevails among many scientists for designating the science of x-rays and, for this reason, many societies are called roentgenological societies. But as that science became enriched later with another and also unforgettable discovery—radium—its combination has been called Radiology. In truth we should speak of roentgenology and curietherapy for indicating these two branches of medicine created by the discoveries of Röntgen and Pierre and Marie Curie. Unfortunately as there is no generic name which includes both without disregard to their discoverers, that of radiology has been adopted for the sake of conciseness. And what better proof is there than that of attending the Second Inter-American Congress of Radiology? Does it not seem more fitting to you that from now on we call these meetings The Inter-American Meetings of Roentgenology and Curietherapy? In this manner we should honor their discoverers and prevent the very general denomination of Radiology from being interpreted by the ignorant as being the science of all luminous radiations, from the light of x-rays and of radium to that of the hertzian waves.

It is impossible to dispense with that so suggestive and renowned "x," and if we are unable to forget that marvellous metal "radium" I ask you that, at least, the societies, assemblies and professorships engaged therein, bear the names of their discoverers. We should no longer encounter difficulties for so doing, as only the modesty of Röntgen and the Curies was able to prevent it.

We find proof of Röntgen's modesty all through the history of his life, before and after the discovery. Who does not remember that, when honored by the king of Bavaria with a decoration and the title of Noble for himself and his descendants,

he rejected that title, which any other would have accepted eagerly. And on reading his first communication "On a New Kind of Ray" does one not perceive the modest man from beginning to end?

Modesty in dress, in attitude, in scientific communications. Modesty in rejecting the most highly merited honors. And modesty in feeling, in thought and in deed. Therein lie the reasons for the exaltation of Röntgen in the eyes of his contemporaries and of posterity. The greatness of a man of science runs parallel to his modesty. If this latter is wanting there is no risk in affirming that the scientific greatness is only apparent and will crumble easily with the passing of time.

A taste for art and comfort in living was acquired by Röntgen even when he was small, as at his home in Holland he could breathe just such an atmosphere surrounded by true works of art originating from his ancestors. In 1866, when he entered the Technical School of Utrecht for the study of algebra, geometry, physics and chemistry, he was only seventeen years of age. It was the period in which he was in the habit of enjoying the country on horseback and skating, and by making long and frequent trips to the surroundings of the city. And it was there that he made the friendship of a companion whom he liked and admired, not only because of his true and loyal friendship, but also because of his great talent as a draftsman. This admiration must have been very great, for Röntgen had no special ability for painting or drawing. It was for this reason that one day when his companion was giving the final touches to the admirable and acrimonious caricature which he had made on the screen of the chimney in the classroom and representing one of the least loved and most feared of the teachers, Röntgen was enraptured as he admired it. His friend had time to retire from the room, after finishing what he considered a work of art, and the arrival of the teacher, the object of the caricature, with difficulty shook Röntgen out of his absorption. And no warnings, punishments or threats of more severe punishments sufficed to make him reveal the name of the author of what the person featured considered to be an unpardonable offense. How can we fail to admire in Röntgen's personality that firmness of character which he possessed from his early days and preserved all through his life? Expulsion from the school meant a definite end to his studies, but he preferred to face that with resignation and strength rather than break the rules of gentlemanliness or to impair, even in the most insignificant degree, his vigorous and arrogant personality. Such a noble though youthful characteristic should not be forgotten, because it serves to explain many of his actions in later life. And his firmness of character had to be on a par with a well tried honesty. Each and every one of his scientific communications abounds with honesty. When reading these communications, one cannot imagine, even for a moment, that there is the slightest dissimulation from the real truth. What a contrast they make with those of so many and so well known pseudo-scientists whose experiences and discoveries can be realized on paper only by themselves. As they are lacking in honesty they skip a link in the chain of experimentation for the purpose of obtaining obvious results, inasmuch as other investigators have never been able to corroborate them.

And let us also remember that letter written to Mrs. Boveri the wife of his great and life-long friend. After explaining to her that within fifteen days, and in accordance with a disposition of the German government, he would have to change the money he had in Italy and America for government bonds, and although being in a position to keep those funds without anyone knowing, he ends by saying, with the greatest simplicity, that he went to look for the employee in charge of the corresponding department in order to inform him that within eight days he would make the change, and adds: "I had great difficulty in convincing him that I had no intention to defraud the state." Neither could the

employee understand such honesty, nor could Röntgen think for a moment of not fulfilling an obligation towards his own conscience and his country.

Honesty and firmness of character should be congenital qualities of man. A beautiful utopia which we most certainly shall not see converted into a reality in the present century and perhaps not in the forthcoming ones. Those who possess it will continue to be select individuals and will be the pride of their race and title.

On December 28, 1895, Röntgen delivered what he called a "Preliminary Communication on a New Kind of Rays." It contains ten pages in which are recorded seventeen experimental facts on the rays discovered by him fifty days before. One does not know what to admire more: the unlimited capacity of a work which he executed, without interruption, during fifty days and nights, as his pauses for food and sleep were insignificant; or the privileged intelligence and exceptional gift of observation which permitted him to establish new and fundamental scientific facts which have preserved their reality and are today as positive as they were fifty years ago.

Untiring steadiness, privileged intelligence, a gift of observation and excessive love of work, combined with learning in the field of physics which was unusual to that period, had to make a real sage of Röntgen. But not even these intellectual conditions, nor those inflexible moral principles of which I have spoken, sufficed to make Röntgen the discoverer of the x-rays. It was necessary tor him to have, in addition, that intangible and, to my way of thinking, supernatural something which has always been an exclusive privilege of a very few, and which we call "genius." Röntgen, in order to make such a prodigious discovery had to be, as he actually was, a *genius*.

And since he was a genius, can we accept his discovery as being the result of mere accident? By no means. It was the culmination of a series of studies and investigations carried out by Röntgen and also by other scientists previously. From the year 600 B.C., in which Tales of Mileto discovered the first phenomenon of electricity on rubbing a piece of amber, till the discovery of the roentgen ray, we find an innumerable number of investigators who, step by step, caused science to advance in the field of electricity.

William Gilbert, who lived from 1540 to 1603, can be considered as the father of electricity. He discovered terrestrial magnetism and used, for the first time, the term "electricity," from the Greek word for amber.

From 1602 to 1691, Torricelli, von Guericke, Schott and Boyle succeeded in forming a vacuum in closed receptables, and studied some of the phenomena that took place there. Newton, Hawksbee, Gray and DuFay, from 1643 to 1739 were already working with machines producing electricity; they studied the sparks and the conduction of electricity by means of metal wires, and they marked two kinds of electricity: the vitreous and the resinous. The Abbé Nollet, Franklin, Galvani, Volta, Oerstedt, Ampère, Ohm and Faraday, between 1700 and 1867, produced electrical and luminous phenomena in the inside of tubes filled with thin air, studied atmospherical electricity, observed the muscular reactions in a frog when subjected to electric current, discovered dry cells, demonstrated the variation of the magnetic needle by electricity and the laws that governed it, pointed out electrostatic induction, and completed the studies on electrical discharges in vacuo. And finally, Hertz, Geissler, Hittorf and Crookes, towards the end of the last century amplified and perfected both the electrical and the luminous phenomena observed in the tubes when subjected to electrical currents, which opened the way to Röntgen for the discovery of the x-rays which were potential in previous discoveries.

And now let us consider for a moment the contributions which roentgen rays have made to medicine in the field of diagnosis and treatment.

We have almost forgotten the incidents that occurred so frequently at the great medical consultations held during the latter part of the last century. The vehemence of every clinician in defense of his viewpoints was such that he seemed more as if he were attending a scientific duel than being in the presence of scientific men seeking the welfare of their patients. The refined observation, the profound clinical experience and the gift of analysis and synthesis of the physicians of that time were much greater than we can imagine. But, unfortunately, there was no way, in many instances, of knowing which of the varied opinions was the right one. Very often the discussions continued on after the death of the patient. The calmness that reigns today in all medical consultations and the minimum vehemence in opinions are due solely to the fact that the laboratory and the roentgen ray, but chiefly the latter, contribute so many positive and certain proofs that they eliminate all impassioned discussions. The clinic has been, and will continue to be in the future, the basis and the support of medical studies. But roentgen rays have given so much and such valuable service, that no one would think of dispensing with a roentgenographic examination as a complement to a clinical study. Just as we would not think of using today the vehicles of the latter half of the last century, because what was then protective sluggishness is now discordant to the age in which we live, so also it would be out of place to use the same slow clinical methods of those times for a diagnosis, even though it be precise.

It is sufficient to mention the different branches of medicine in order to appreciate the priceless help that roentgen rays are giving to clinical diagnosis today.

Permit me to mention some of the roentgenographic examinations made, and some of the facts relating to them, which I think should not be forgotten.

Orthopedics has attained its present stage thanks to roentgenography.

Examination of the digestive organs has not only facilitated a study of the structure of mucosa but it provides for a diagnosis which a microscopical examination is unable to prove. The same occurs in the case of incipient gastric cancer which Guttman has taught us to discover roentgenographically, and which this Congress is studying as one of its main subjects.

In a roentgenographic study of the urinary system we have learned physiological rudiments that were unknown before, such as the paralyzation of the functions of a kidney in certain cases of calculous obstructions of the ureter by which means Nature very wisely forestalls the formation of hydronephrosis.

And the eyes of the scientific world can contemplate all the improvements attained in the diagnosis of the injuries to the nervous system, the heart, the veins, the arteries, the joints, and so forth, whether ordinary methods are employed or whether on occasions biopsies are sought.

And in the study of the thorax for the diagnosis of pleuropulmonary diseases, I should like to refer to the work of a Latin-American, my dear friend and colleague, Manuel D'Abreu. Ten years ago roentgen photography, or abreuography, as we should call it, was endeavoring, with great difficulty, to find a way into the field of science. The tenacity and energy of Manuel D'Abreu were necessary for convincing the hygienists, little by little, what a collective examination meant, in low cost, in tuberculosis case finding in large masses of people. Then came the struggle; and today, when we should acknowledge the friend and scientist as the one responsible for the introduction of the method, one only hears of modifications, innovations, reforms and improvements effected in a process of examination considered as antiquated and given to the world by enchantment. As this Congress is considering roentgen photography as one of its principal themes, I have thought it fair and natural that we pay to our esteemed friend Manuel D'Abreu the well deserved tribute of our admiration.

And as I refer now to what has been attained with roentgen rays in the field of therapeutics, I should like to deal, with special emphasis, not on so many and so varied conditions which radiations cure or improve, but solely on the importance of therapeutics in cancer and inflammatory diseases. In the case of the former, because, in spite of the great and clearly accepted success achieved in this field I do not think that either roentgen therapy, curietherapy or surgery is the method which will, in the future, put an end to cancer; in the case of the latter, because the way in which roentgen rays work in cases of infection is exactly the foundation on which, within a few years, the treatment and cure of diseases will be based.

Until we know the exact cause of the cellular disturbance known as cancer, while we have to be attacking cellular insurrections appearing in any part of our organism, without the certainty that this dissociative element has not sent out an exciting agent to some other distant part to provoke a more serious insurrection than the first, we shall never control cancer. We cannot accept as the goal of therapeutics the mere presentation of more or less high percentages of healings and survivals in cases which, had it not been for the treatment, would have been fatal in a short time. The cause of cancer must be found, as it will be—even though it takes a long time—and when this happens, the element or process which will put an end to so dreadful a scourge will come to light. In the meantime roentgen and curie therapists and surgeons must feel proud of having cured or alleviated thousands of cancerous patients who, without their help, would have had no hope of consolation. Let us forge ahead in the perfection of technique and methods for these treatments, because in this way we shall improve on actual results, but let us not be deluded into thinking that radiation and surgery are the weapons with which we can finally conquer cancer. As cures are far more frequent in incipient cases, let us continue to impress upon the public the necessity of undergoing treatment quickly, as thus their probabilities of cure will be greatly increased.

There is great scientific pessimism and a desire for excellence in what I have just expounded, but in no way is it a reason for discouragement on the part of the victims of cancer because cures are increasing daily as patients seek specialists more quickly. We can hardly ask more from a therapist who is struggling against an enemy of whose origin he is completely ignorant.

Although roentgen rays have no direct action on bacteria, such magnificent results have been obtained in the treatment of many inflammatory cases of bacterial origin, that several investigators, led by Heidenhain and Fried devoted their attention to a careful study of the action of roentgen rays on persons irradiated for different illnesses such as sinusitis, mastoiditis, and furunculosis, which have reacted favorably to irradiation. It has been possible to demonstrate that its entire mechanical action was limited to the improvement and increase of the natural defenses against infection. Roentgen rays, administered in small doses, destroy the most vulnerable leukocytic elements which gather in great numbers in the infected part, and thus they liberate the antibodies which they carry for the struggle. But as the attacking elements die the organism sends out new troops of white cells to replace the preceding ones, and finally the moment arrives when the attack is held and the infection defeated. This therapy, as shown by Wintz, provokes an impact in the human body similar in its humoral symptomatology to that produced by foreign substances such as proteins, colloids, and so forth. As in the case of every impact, it produces a sudden change in the colloidal equilibrium of the plasma and is revealed by constant humoral phenomena demonstrated by Wintz in irradiated individuals. There are modifications of the hydrogen ion concentration, delay in the period of coagulation, leukopenia, drop in blood pressure, hyperglycemia, hypervago-

tonia, and so forth. But as it has to do with an impact caused by the very substances of the organism under treatment, it is evident that its therapeutic effect must be better, more effective, and subject to less surprises than if produced by elements that are foreign to the human body. But the effect of roentgen therapy in inflammatory cases also explains its results. Sometimes the cure takes place rapidly; on other occasions it is slow; sometimes its effect is limited to a temporary relief for the patient; and when administered in small doses it is never harmful to the organism. It is logical that it should be so, inasmuch as all that we do is to activate the natural defenses of each of the persons irradiated. The great individual reactions which we find in them will cause the improvement in the patients to be more or less rapid and complete.

The day when therapeutics will be restricted, as is roentgen therapy to inflammatory diseases, to seek the natural health of which Carrel speaks, thus increasing the natural defenses of man, and to struggle against the few diseases which may present themselves in organisms previously well defended, the opinions of humanity on life and disease will be changed completely.

We have often quoted the following providential words of Alexis Carrel, and with which I am in absolute accord. Listen to them:

> As we know, there are two kinds of health—natural and artificial. We covet natural health which comes from the resistance of the tissues to infectious and degenerative diseases, from the equilibrium of the nervous system. And not the artificial health which depends on nourishing diets, serums, endocrinous products, vitamins, periodical medical examinations, and on expensive medical protection, hospitals and nurses. Man ought to have been created in such a way as not to be in need of these cares. Medicine will have attained its greatest triumph when it discovers the manner of ignoring sickness, fatigue and fear. We should give to humanity liberty and happiness resulting from the perfection of organic and mental activities.

On reading the interesting account which Lieutenant Colonel Lewis E. Etter gives of his visit to the Roentgen Laboratory, in Würzburg, after World War II, I have experienced an intense emotion. Two hundred and forty thousand incendiary bombs were hurled on Würzburg on March 16, 1945. The greater part of the city was destroyed but, by nothing less than a miracle, almost the whole of the Institute of Physics and that commemorative plate, which says, in translation, "In this house, in the year 1895, W. C. Röntgen discovered the rays which were named after him," remained intact, whereas the Institute of Anatomy and other neighboring buildings were completely destroyed. This amazing fact convinces us very clearly that Röntgen and his work are above the hatred and the struggles which present themselves periodically between nations.

In the same way, this is being shown by the members of the second Inter-American Congress of Radiology in this tribute. A group of men of science, appertaining to the United Nations, on meeting here today, and who have just ended their struggle against Nazi Germany, have thought it fit to pay tribute to science represented in a genius born in the very Germany which they have just fought.

Just as Röntgen must have suffered in the other world on seeing the sad and erroneous route which his native land had taken in, what was at that time, recent years, today he must feel pride on seeing that in this noble and cordial city of Havana, many of his disciples and admirers have met to seek the same ideals which he sought during his life.

Havana has always been a center of science and medical investigation, not only in the field of radiology, but also in all branches of medicine. It is enough, for today, to quote as illustrious examples of those who continue to carry on his work, the names of some notable Cuban investigators now dead.

Years before the eminent figure of

President Grau San Martin was known as a leader, and before he was admired by the political world, we, the doctors of America, recognized in him the perfect physiologist, the careful investigator and the famous teacher whose teachings had already crossed the borders of the country.

And in Dr. Pedro L. Fariñas, the esteemed President of this Congress, we see the man of science who, like Röntgen, has converted modesty into his most sublime virtue.

As Americans, let us seek the scientific union of all the radiologists in the world, and remembering Röntgen and his work, let us do all that we can to combine the Third Inter-American Congress of Roentgenology and Curietherapy, which will take place in 1949, with the Sixth World Congress, so that we may meet again fraternally, and under the protection and guidance of ideals similar to those of the radiologists of five continents.

My dear companions: let us pray that the science of Roentgenology will continue to be, as a science, the goal of our lives.

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

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Publisher: CHARLES C THOMAS, 301–327 East Lawrence Avenue, Springfield, Illinois.

Issued Monthly. Subscription $10.00 per year, $11.00 in Canada and $12.00 in foreign countries. Advertising rates submitted on application: Editorial office, 110 Professional Building, Detroit, Mich., Office of publication, 301–327 East Lawrence Avenue, Springfield, Ill. Information of interest to all readers will be found on page vi.

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Forty-ninth Annual Meeting: Palmer House, Chicago Ill., Sept. 14–17, 1948.

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Thirtieth Annual Meeting: Stevens Hotel, Chicago, Ill., June 20–22, 1948.

EDITORIALS

THE ANNUAL MEETING OF THE AMERICAN ROENTGEN RAY SOCIETY

THE Forty-ninth Annual Meeting of the American Roentgen Ray Society is to be held at the Palmer House, Chicago, Illinois, September 14–17, 1948. The selection of the Palmer House as a meeting place is an excellent one as the hotel facilities are, as all the members of the Society know, ample to house the Scientific and Technical Exhibits, and the rooms that are available for the Scientific Sessions and the Instruction Courses cannot be surpassed. The Society returns to Chicago with very pleasant memories of the Joint Meeting with the Radiological Society of North America which was held in Chicago in September of 1944.

The program which has been arranged by the Chairman of the Program Committee, President Elect Reynolds and his committee should make an especial appeal to all those attending the meeting. The Program Committee has endeavored to restrict somewhat the number of papers that are being given in order that more general discussion of the papers may be had.

Particular attention is called to the splendid round table discussions and symposiums that have been arranged, as well as to the group of instructive general papers.

The Preliminary Program of the meeting is given elsewhere in this issue of the JOURNAL and it is urged that these pages be read carefully. It can readily be seen that the Program Committee has enlisted the services of some of the leading medical men—internists, surgeons, pathologists and radiologists—and the symposium dealing with radiobiology in its relation to radiology is unsurpassed not only in the timeliness of the discussion of such an important subject, but the participants in the program are outstanding in their respective fields.

The Caldwell Lecture—this year on Wednesday evening—will be given by Dr. B. R. Kirklin, Chief of the Section of Roentgenology, Mayo Clinic; Director of the Division of Radiology and Professor of Radiology, Mayo Foundation Graduate School, University of Minnesota, Rochester, Minnesota. Dr. Kirklin needs no introduction to the medical or radiological world. The topic which Dr. Kirklin has chosen—"Graduate Education in Roentgenology"—is of great importance to the medical profession and there is no one who is better equipped to discuss this phase of roentgenology,

The Instruction Courses this year are under the directorship of Dr. Harry M. Weber. These courses are always an important feature of the annual meetings and the splendid courses which have been arranged by Dr. Weber are published elsewhere in this issue of the JOURNAL. Since the number who may attend these courses is limited it is urged that those who anticipate taking these courses fill out the order blank at once.

The Chairman of the Scientific Exhibit Committee, Dr. Wilbur Bailey, and his committee have arranged a superb exhibit, many of the scientific exhibits amplifying and extending the papers that are to be given in the Scientific Program.

The Technical Exhibit which is always of importance to the annual meetings is this year the largest that the Society has ever had and should provoke a great deal of interest. The Program Committee has

allotted a sufficient time during the morning and afternoon for viewing the Scientific and Technical Exhibits.

The social functions of the meeting have not been neglected. The Annual Banquet, with well chosen entertainment, is to be held on Thursday evening and the Ladies Entertainment Committee has arranged an excellent and varied program for the visiting ladies.

The forthcoming meeting in Chicago should stimulate much interest and should attract a large number of radiologists, and in view of this fact it is urged that all who anticipate attending the meeting make their reservations with the Palmer House at the earliest possible moment.

ALFRED FRANKLIN HOCKER
1902–1948

ALFRED FRANKLIN HOCKER, a member of the American Radium Society, died suddenly at his home at 14 East 90th Street, New York, on February 12, 1948, of a coronary thrombosis.

On the day preceding his death he had followed his usual routine; he had performed an operation in the morning, worked in the Out-Patient clinic at Memorial Hospital and in his office in the afternoon. In the evening, he had attended the theater with his wife and friends and his death occurred suddenly, shortly after midnight.

Dr. Hocker, mainly of Swiss ancestry, was born on April 20, 1902, in Audubon, Iowa, the son of Franklin Pierce Hocker and Ida (Sauer) Hocker. When he was four years old the family moved to El Reno, Oklahoma, where he attended and graduated from the public schools. In 1920 he enrolled in the College of Liberal Arts at the University of Oklahoma, and in 1922 he began the study of medicine at the University of Louisville Medical School, receiving the degree of Doctor of Medicine in 1926. After an internship of eighteen months in the Louisville City Hospital and two years of general practice in El Reno, he was appointed an intern at the Memorial Hospital in New York in January, 1931. In July, 1931, he began a three year service as a Rockefeller Fellow in Cancer Research at the Memorial Hospital, finishing in July, 1934, with a year's service as Resident Surgeon.

In 1934 he began the practice of medicine as a specialist in the treatment of cancer by surgery and radiation and his staff appointments during his early years of practice were: Assistant Professor of Radiology at Cornell University, Assistant Surgeon in Otolaryngology at New York Hospital, Consulting Radiologist, New York Hospital, Associate Radiologist at the Memorial Hospital and at the White Plains Hospital. In 1936 he took an active part in the establishment of a tumor clinic at the Cornwall (New York) Hospital and soon became its Director, a position which he held until the time of his death. In 1941 his appointment at Memorial Hospital was changed to Assistant Attending Surgeon assigned to the Head and Neck Service. Although he maintained a country home at St. James on the North Shore of Long Island, he nevertheless devoted nearly every Saturday to his tumor clinic at Cornwall, time which he might otherwise have spent in restful relaxation in the country with his family and friends.

During his whole professional life he limited his practice to the treatment of neoplastic diseases. Though a thoroughly trained and active surgeon, he maintained an equal interest in radiation therapy wherever indicated in the treatment of neoplastic diseases, and did much to standardize irradiation techniques. Among his contributions to the science of cancer therapy was the development (in collaboration) of a technique for sialography in the diagnosis of tumors of the major salivary glands. He was the clinical member of the Committee for the Study of Radioactive Isotopes in the Treatment of Thyroid Cancer at Memorial Hospital.

Dr. Hocker was a Fellow of the American College of Surgeons, a Diplomate of the American Board of Radiology, a member of the American College of Radiology, American Medical Association, American Radium Society, New York Roentgen Ray Society, and the New York Academy of Medicine.

In 1932 he married Margaret Summers Lane of Richmond, Kentucky, and a son, Alfred Franklin Hocker, Jr. was born in 1936. He is survived by his wife and son, his mother, Mrs. Franklin Pierce Hocker of El Reno, and a brother, Carl Hocker of Seattle.

Al Hocker died a relatively young man but he had lived a full, useful, and busy life. His death came as most doctors would prefer it, after a busy day when he had followed his usual active routine, in the operating-room, the clinic, and his office. His medical colleagues, both at Memorial Hospital and throughout the United States were deeply saddened by his untimely death. The universal esteem and affection which he inspired among those who knew him can perhaps be expressed here, though somewhat inadequately, in the words of a resolution passed by the Medical Board of the Memorial Hospital, which reads as follows:

"At its regular meeting on April 6, 1948, the Medical Board resolves that the Memorial Hospital has suffered an irreparable loss in the sudden death of Dr. Alfred Franklin Hocker, one of the most beloved and widely respected members of its staff.

"Only in retrospect can one begin to ap-

preciate the scope and the depth of his influence upon us, his associates, and upon the institution as a whole. Wherever Al Hocker lived and moved the atmosphere of human relations was bound to be more friendly under the force of his warm and generous personality. His kindliness and sympathetic understanding inspired an immediate and lasting affection in all those with whom he came in contact. He was generous and tolerant in his judgments of others, and modest in his opinion of his own achievements. He took no part or side in minor disagreements. The universal esteem and affection which he possessed inspired many of his associates to emulate, in some degree, his unselfish and generous example. His work will be taken up and carried on by others, but the death of Al Hocker leaves a void in the hearts of his many friends and patients which can never be filled."

Hayes Martin

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this section solicited promptly after the events to which they refer

MEETINGS OF ROENTGEN SOCIETIES*

UNITED STATES OF AMERICA

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. H. Dabney Kerr, University Hospital, Iowa City, Iowa. Annual meeting: Palmer House, Chicago, Ill., Sept. 14–17, 1948.

AMERICAN RADIUM SOCIETY
Secretary, Dr. H. F. Hare, 605 Commonwealth Ave., Boston, Mass. Annual meeting: 1949, to be announced.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. D. S. Childs, 607 Medical Arts Bldg., Syracuse, N. Y. Annual meeting: Hotels Fairmont and Mark Hopkins. San Francisco, Calif., Dec. 5–10, 1948.

AMERICAN COLLEGE OF RADIOLOGY
Secretary, Mac F. Cahal, 20 N. Wacker Drive, Chicago 6. Annual meeting: 1949, to be announced.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. U. V. Portmann, Cleveland Clinic, Cleveland, Ohio, Annual Meeting: 1949, to be announced.

ALABAMA RADIOLOGICAL SOCIETY
Secretary, Dr. C. S. Stickley, 515 Bell Bldg., Montgomery, Ala. Next meeting time and place of Alabama State Medical Association.

ARKANSAS RADIOLOGICAL SOCIETY
Secretary, Dr. Fred Hames, 511 National Bldg., Pine Bluff, Ark. Meets every three months and also at time and place of State Medical Association.

BROOKLYN ROENTGEN RAY SOCIETY
Secretary, Dr. A. H. Levy, 1354 Carroll St., Brooklyn 13, N. Y. Meets monthly on fourth Tuesday, October to April.

BUFFALO RADIOLOGICAL SOCIETY
Secretary, Dr. Mario C. Gian, 610 Niagara St., Buffalo, N. Y. Meets second Monday evening each month, October to May inclusive.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. Dwight V. Needham, 608 E. Genesee St., Syracuse, N. Y. Three meetings a year January, May, November.

CENTRAL OHIO RADIOLOGICAL SOCIETY
Secretary, Dr. Paul D. Meyer, Grant Hospital, Columbus, Ohio. Meets at 6:30 P.M. on second Thursday of October, December, February, April, and June at Seneca Hotel, Columbus, Ohio.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. T. J. Wachowski, 310 Ellis Ave., Wheaton, Ill. Meets second Thursday of each month October to April inclusive at the Palmer House.

CINCINNATI RADIOLOGICAL SOCIETY
Secretary, Dr. Eugene L. Saenger, 735 Doctors Bldg., Cincinnati 2, Ohio. Meets last Monday of each month, September to May, inclusive.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. George L. Sackett, 10515 Carnegie Ave. Cleveland 6, Ohio. Meetings at 6:30 P.M. on fourth Monday of each month from October to April.

DALLAS-FORT WORTH ROENTGEN STUDY CLUB
Secretary, Dr. X. R. Hyde, Medical Arts Bldg., Fort Worth, Texas. Meets in Dallas on odd months and in Fort Worth on even months, on third Monday, 7:30 P.M.

DENVER RADIOLOGICAL CLUB
Secretary, Dr. Mark S. Donovan, 306 Majestic Bldg., Denver 2, Colo. Meets third Friday of each month at Department of Radiology, Colorado School of Medicine.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. E. R. Witwer, Harper Hospital. Meets monthly on first Thursday from October to May, at Wayne County Medical Society Building.

FLORIDA RADIOLOGICAL SOCIETY
Secretary, Dr. J. A. Beals, St. Luke's Hospital, Jacksonville, Fla. Meets twice yearly, in April preceding annual meeting of Florida Medical Society, and in November.

GEORGIA RADIOLOGICAL SOCIETY
Secretary, Dr. Robert Drane, DeRenne Apartments, Savannah, Ga. Meets in mid-winter and at annual meeting of Medical Association of Georgia in the spring.

HOUSTON X-RAY CLUB
Secretary, Dr. Curtis H. Burge, 3020 San Jacinto St., Houston 4, Texas. Meets fourth Monday each month.

RADIOLOGICAL SOCIETY OF KANSAS CITY
Secretary, Dr. Arthur B. Smith, 800 Argyle Bldg., Kansas City, Mo. Meets third Thursday of each month.

ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. Wm. DeHollander, St. John's Hospital, Springfield, Ill. Meets three times a year.

INDIANA ROENTGEN SOCIETY
Secretary, Dr. J. A. Campbell, Indiana University Hospitals, Indianapolis 7. Meets second Sunday in May.

IOWA X-RAY CLUB
Secretary, Dr. Arthur W. Erskine, 326 Higley Bldg., Cedar Rapids, Iowa. Luncheon and business meeting during annual session of Iowa State Medical Society. Special meetings by announcement.

KANSAS RADIOLOGICAL SOCIETY
Secretary, Dr. Anthony F. Rossitto, Wichita Hospital, Wichita, Kansas. Meets annually with the State Medical Society.

KENTUCKY RADIOLOGICAL SOCIETY
Secretary, Dr. W. C. Martin, 321 W. Broadway, Louisville. Meets annually in Louisville on first Saturday in Apr.

LONG ISLAND RADIOLOGICAL SOCIETY
Secretary, Dr. Marcus Wiener, 1430-48th St., Brooklyn, N. Y. Meets Kings County Med. Soc. Bldg. monthly on fourth Thursday, October to May, 8:45 P.M.

LOS ANGELES RADIOLOGICAL SOCIETY
Secretary, Dr. Moris Horwitz, 441 No. Camden Drive, Beverly Hills, Calif. Meets second Wednesday each month at Los Angeles County Medical Assn. Building.

LOUISIANA RADIOLOGICAL SOCIETY
Secretary, Dr. J. R. Anderson, 1130 Louisiana Ave., Shreveport. Meets annually during Louisiana State Medical Society Meeting.

LOUISVILLE RADIOLOGICAL SOCIETY
Secretary, Dr. E. L. Pirkey, Louisville General Hospital, Louisville 2, Ky. Meets monthly on second Friday at Louisville General Hospital.

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS
Secretary, Dr. R. D. McDuff, 220 Genesee Bank Bldg., Flint 3, Mich.

MILWAUKEE ROENTGEN RAY SOCIETY
Secretary, Dr. C. A. H. Fortier, 231 W. Wisconsin Ave.,

* Secretaries of societies not here listed are requested to send the necessary information to the Editor.

Milwaukee, Wis. Meets monthly on second Monday at University Club.

Minnesota Radiological Society
Secretary, Dr. Chauncey N. Borman, 802 Medical Arts Bldg., Minneapolis 2, Minn. Two meetings yearly, one at time of Minnesota State Medical Association the other in the fall.

Nebraska Radiological Society
Secretary, Dr. Ralph C. Moore, Nebraska Methodist Hospital, Omaha 3, Nebr. Meets third Wednesday of each month, at 6 P.M. at either Omaha or Lincoln.

New England Roentgen Ray Society
Secretary, Dr. George Levene, Massachusetts Memorial Hospitals, Boston, Mass. Meets monthly on third Friday, Boston Medical Library.

New Hampshire Roentgen Ray Society
Secretary, Dr. A. C. Johnston, Elliott Community Hospital, Keene, N. H. Meets four to six times yearly.

New York Roentgen Society
Secretary, Dr. Ramsay Spillman, 115 East 61st St., New York City. Meets monthly on third Monday, New York Academy of Medicine, at 8:30 P.M.

North Carolina Radiological Society
Secretary, Dr. J. E. Hemphill, 323 Professional Bldg., Charlotte 2, N. C. Meets in May and October.

North Dakota Radiological Society
Secretary, Dr. C. O. Heilman, 807 Broadway, Fargo. Meetings held by announcement.

Northern California Radiological Club
Secretary, Dr. C. E. Grayson, Medico-Dental Bldg., Sacramento 14, Calif. Meets at dinner last Monday, every second month, except June, July and August. Next meeting Sept. 27, 1948.

Ohio State Radiological Society
Secretary, Dr. Carroll C. Dundon, 2065 Adelbert Road, Cleveland 6, Ohio.

Oklahoma State Radiological Society
Secretary, Dr. W. E. Brown, Tulsa, Okla. Three regular meetings annually.

Oregon Radiological Society
Secretary, Dr. William Y. Burton, 242 Medical Arts Bldg., Portland 5, Oregon. Meets monthly 2nd Wednesday, 8:00 P.M., Library of University of Oregon Medical School.

Orleans Parish Radiological Society
Secretary, Dr. Joseph V. Schlosser, Charity Hospital, New Orleans 13, La. Meets first Tuesday of each month.

Pacific Northwest Radiological Society
Secretary, Dr. S. J. Hawley, 1320 Madison St., Seattle 4, Wash. Meets annually in May.

Pacific Roentgen Society
Secretary, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif. Meets annually, during meeting of California Medical Association.

Pennsylvania Radiological Society
Secretary, Dr. J. M. Converse, 416 Pine St., Williamsport.

Philadelphia Roentgen Ray Society
Secretary, Dr. Arthur Finkelstein, Graduate Hospital, 19th and Lombard St. Meets first Thursday each month October to May, at 8:00 P.M., in Thomson Hall, College of Physicians.

Pittsburgh Roentgen Society
Secretary, Dr. R. P. Meader, 4002 Jenkins Arcade Pittsburgh 22, Pa. Meets 6:30 P.M. at Webster Hall Hotel on second Wednesday each month, October to May inclusive.

Queens Roentgen Ray Society
Secretary, Dr. J. E. Goldstein, 88-29 163rd St., Jamaica 3, N. Y. Meets fourth Monday of each month except during the summer.

Radiological Section, Baltimore Medical Society
Secretary, Dr. Harry A. Miller, 2452 Eutaw Place, Baltimore. Meets third Tuesday each month, September to May.

Radiological Section, Connecticut Medical Society
Secretary, Dr. Robert M. Lowman, Grace-New Haven Community Hospital, New Haven 11. Meets bimonthly second Thursday, at place selected by Secretary.

Radiological Section, District of Columbia Medical Society
Secretary, Dr. A. A. J. Den, 1801 K St., N. W., Washington, D. C. Meets Medical Society Auditorium, third Thursday, January, March, May, October at 8:00 P.M.

Radiological Section, Southern Medical Association
Secretary, Dr. Roy G. Giles, Temple, Texas.

Radiological Society of New Jersey
Secretary, Dr. Raphael Pomeranz, 31 Lincoln Park, Newark, N. J. Meets annually at time and place of State Medical Society. Mid-year meetings at place chosen by president.

Rochester Roentgen Ray Society, Rochester, N. Y.
Secretary, Dr. Murray P. George, Strong Memorial Hospital. Meets monthly on third Monday from October to May, inclusive, 8 P.M. at Strong Memorial Hospital.

Rocky Mountain Radiological Society
Secretary, Dr. Maurice D. Frazer, 1037 Stuart Bldg., Lincoln, Nebr. Meets Salt Lake City, Utah, at Hotel Utah, Aug. 12, 13, 14, 1948.

St. Louis Society of Radiologists
Secretary, Dr. Edwin C. Ernst, Beaumont Medical Building, St. Louis, Mo. Meets fourth Wednesday of each month, except June, July, August, and September.

San Diego Roentgen Society
Secretary, Dr. R. F. Niehaus, 1831 Fourth Ave., San Diego, Calif. Meets monthly, first Wednesday at dinner.

Section on Radiology, California Medical Association
Secretary, Dr. D. R. MacColl, 2007 Wilshire Blvd., Los Angeles 5, Calif.

Section on Radiology, Illinois State Medical Society
Secretary, Dr. Edwin L. Rypins, 427 N. Main St., Bloomington, Ill.

Shreveport Radiological Club
Secretary, Dr. R. W. Cooper, Charity Hospital, Shreveport, La. Meets monthly on third Wednesday, at 7:30 P.M., September to May inclusive.

South Carolina X-Ray Society
Secretary, Dr. T. A. Pitts, Baptist Hospital, Columbia, S. C. Meets in Charleston on first Thursday in November, also at the time and place of South Carolina State Medical Association.

Tennessee Radiological Society
Secretary, Dr. J. M. Frère, 707 Walnut St., Chattanooga, Tenn. Meets annually at the time and place of the Tennessee State Medical Association.

Texas Radiological Society
Secretary, Dr. R. P. O'Bannon, 650 Fifth Ave., Fort Worth 4, Texas.

University of Michigan Department of Roentgenology Staff Meeting
Meets each Monday evening from September to June, at 7 P.M. at University Hospital.

University of Wisconsin Radiological Conference
Secretary, Dr. E. A. Pohle, 1300 University Ave., Madison, Wis. Meets first and third Thursdays 4:00 to 5:00 P.M., September to May inclusive. Room 203, Service Memorial Institute, 426 N. Charter St., Madison.

Utah Radiological Conference
Secretary, Dr. Henry H. Lerner, School of Medicine, University of Utah, Salt Lake City 1. Meets 1st and 3rd Thursdays monthly from 7:30 to 10 P.M., Salt Lake County General Hospital, September to June.

UTAH STATE RADIOLOGICAL SOCIETY
Secretary, Dr. M. Lowry Allen, Judge Bldg., Salt Lake City 1, Utah. Meets third Wednesday in September, November, January, March and May.

VIRGINIA RADIOLOGICAL SOCIETY
Secretary, Dr. P. B. Parsons, Norfolk General Hospital, Norfolk, Va. Meets annually in October.

WASHINGTON STATE RADIOLOGICAL SOCIETY
Secretary, Dr. Homer V. Hartzell, 310 Stimson Bldg., Seattle 1, Wash. Meets fourth Monday each month, October through May, College Club, Seattle.

X-RAY STUDY CLUB OF SAN FRANCISCO
Secretary, Dr. Ivan J. Miller, 2000 Van Ness Ave. Meets monthly on third Thursday at 7:45 P.M., first six months of year at Lane Hall, Stanford University Hospital, and second six months at Toland Hall, University of California Hospital.

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPIA DE CUBA
President, Dr. J. Manuel Viamonte, Hospital Mercedes, Habana, Cuba. Meets monthly in Habana.

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGIA Y FISIOTERAPIA
General Secretary, Dr. D. P. Cossio, Marsella No. 11, Mexico, D. F. Meets first Monday of each month.

BRITISH EMPIRE

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE ROENTGEN SOCIETY
Medical Members' meeting held monthly on third Friday at 2:30 P.M. and Ordinary Meeting at same time on following Saturday, October to May, 32 Welbeck St., London, W.1.

FACULTY OF RADIOLOGISTS
Secretary, Dr. M. H. Jupe, 23 Welbeck St., London, W.1 England.

SECTION OF RADIOLOGY OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)
Meets third Friday each month at 4:45 P.M. at the Royal Society of Medicine, 1 Wimpole St., London.

CANADIAN ASSOCIATION OF RADIOLOGISTS
Honorary Secretary, Dr. E. M. Crawford, 2100 Marlowe Ave., Montreal 28, Que. Meetings January and June.

SECTION OF RADIOLOGY, CANADIAN MEDICAL ASSOCIATION
Secretary, Dr. C. M. Jones, Inglis St., Ext. Halifax, N. S.

SOCIÉTÉ CANADIENNE-FRANCAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES
Secretary, Dr. Origéne Dufresne, 4120 Ontario St., East, Montreal, P. Q.

AUSTRALIAN AND NEW ZEALAND ASSOCIATION OF RADIOLOGISTS
Honorary Secretary, Dr. Alan R. Colwell, 135 Macquarie St., Sydney, N.S.W.
Honorary Secretaries, State Branches:
New South Wales, Dr. E. W. Frecker, 135 Macquarie St., Sydney.
Victoria, Dr. T. L. Tyrer, 3 Lockerbie Court, East St. Kilda.
Queensland, Dr. J. Adam, 131 Wickham Terrace, Brisbane.
South Australia, Dr. B. C. Smeaton, 178 North Terrace, Adelaide.
Western Australia, Dr. A. M. Nelson, 179-B St. Georges Terrace, Perth.
New Zealand, Dr. E. G. Lynch, 12 Bolton St., Wellington.

SOUTH AMERICA

SOCIEDAD ARGENTINA DE RADIOLOGIA
Secretary, Dr. Guido Gotta, Buenos Aires, Argentina. Meetings are held monthly.

SOCIEDADE BRASILEIRA DE RADIOLOGIA MEDICA
Secretary, Dr. Nicola Caminha, Av. Mem de Sa, Rio de Janeiro, Brazil. Meets monthly, except during January, February and March.

SOCIEDADE BRASILEIRA DE RADIOTERAPIA
Secretary, Dr. Andrelino Amaral, Av. Brigadeiro Luiz Antonio, 644, São Paulo, Brazil. Meets monthly on second Tuesday at 9 P.M. in São Paulo at Av. Brigadeiro Luiz Antonio, 644.

SOCIEDAD PERUANA DE RADIOLOGIA
Secretary, Dr. Julio Bedoya Paredes, Apartado, 2306 Lima, Peru. Meetings held monthly except during January, February and March, at the Asociación Médica Peruana "Daniel A. Carrión," Villalta, 218, Lima.

CONTINENTAL EUROPE

SOCIÉTÉ BELGE DE RADIOLOGIE
General Secretary, Dr. S. Masy, 111 Avenue des Alliés, Louvain, Belgium. Meets monthly, second Sunday at Maison des Médecins, Brussels.

CESKOSLOVENSKÁ SPOLEČNOST PRO RÖNTGENOLOGII A RADIOLOGII V PRAZE
Secretary, Dr. Roman Bláha, Praha XII, stát. nemocnice, Czechoslovakia. Meets monthly except during July, August, and September. Annual general meeting.

POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. L. Zgliczynski, 59 Nowogrodzka St., Warsaw, Poland. Next meeting May 13 and 14, 1948.

GDANSK SECTION, POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. A. Smigielska, Akademia Lekarska, Gdansk. Meets monthly last Sunday at 10.30, X-Ray Dept., Akademia Gdansk.

WARSAW SECTION, POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. L. Zgliczynski, 59 Nowogrodzka St., Warsaw, Poland. Meets monthly.

SOCIETATEA ROMANA DE RADIOLOGIE SI ELECTROLOGIE
Secretary, Dr. Oscar Meller, Str. Banual Mărăcine, 30, S. I., Bucuresti, Roumania. Meets second Monday in every month with the exception of July and August.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD.
USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson. Meets annually.

LENINGRAD ROENTGEN RAY SOCIETY
Secretaries, Drs. S. G. Simonson and G. A. Gusterin. Meets monthly, first Monday at 8 o'clock, State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky. Meets monthly, first Monday, 8 P.M.

SCANDINAVIAN ROENTGEN SOCIETIES
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association.

SOCIEDAD ESPANOLA DE RADIOLOGIA Y ELECTROLOGIA
Secretary, Dr. J. Martin-Crespo, Fuencarral, 7. Madrid, Spain. Meets monthly in Madrid.

SCHWEIZERISCHE RÖNTGEN-GESELLSCHAFT (SOCIÉTÉ SUISSE DE RADIOLOGIE)
President, Dr. H. E. Walther, Gloriastr. 14, Zürich, Switzerland.

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY MEETING, SALT LAKE CITY, UTAH, AUGUST 12, 13, 14, 1948

The tenth mid-summer conference of the Rocky Mountain Radiological Society will be held at the Hotel Utah in Salt Lake City, Utah, on August 12, 13 and 14, 1948. The program includes the following guest speakers:

John D. Camp, M.D., Rochester, Minnesota: "Sources of Error in Encephalography and Ventriculography"; "Significant Roentgenologic Findings in Intracranial Disease."

Ross Golden, M.D., New York City, N. Y.: "Some Problems Connected with the Detection of Carcinoma of the Stomach"; "Disturbances in the Small Intestine Connected with Disease of the Mesentery."

John Caffey, M.D., New York City, N. Y.: "Congenital Obstructions of the Alimentary Tract"; "Two New Syndromes of Growing Bone."

Wendell G. Scott, M.D., St. Louis, Missouri: "Importance of Early Diagnosis of Carcinoma of the Colon"; "Low Back Pain and the Evaluation of Radiographic Methods of Diagnosis."

Juan A. del Regato, M.D., Columbia, Missouri: "Treatment of Carcinoma of the Lower Lip"; "Transvaginal Roentgen Therapy for Carcinoma of the Cervix."

L. Henry Garland, M.D., San Francisco, California: "Sarcoidosis of Boeck."

On the evening of August 12 there will be a joint meeting of the Society with the Salt Lake County Medical Society, to be followed by a Dutch Lunch. The annual banquet will be held in the Lafayette Ballroom of the Hotel Utah on the evening of August 13. The toastmaster will be Mac F. Cahal, Secretary of the American College of Radiology, and the principal speaker will be Dr. Henry Garland. Other entertainment features include a sight-seeing trip around Salt Lake City and a trip by bus to the great Bingham Copper Mine and the Great Salt Lake. The meeting will conclude on the afternoon of August 14 with an outdoor steak dinner at Maxfields Lodge in Big Cottonwood Canyon. All Radiologists are cordially invited to attend this meeting and participate in the proceedings.

COURSE IN APPLICATION OF NUCLEAR PHYSICS

The University of California in cooperation with the University Medical Schools at Los Angeles and San Francisco will present a course in "The Application of Nuclear Physics to the Biological and Medical Sciences," to be given at the University of California at Los Angeles, August 2 through August 20, 1948, under the auspices of Medical Extension. Seventeen officers of instruction will give the courses.

General Chairman: Stafford L. Warren, M.D., Professor of Biophysics and Dean of the School of Medicine, University of California, Los Angeles.

Director of Course: Fred A. Bryan, M.D., Associate Clinical Professor of Medicine, School of Medicine, University of California, Los Angeles.

Director of Laboratory: D. Harold Copp, Ph.D., M.D., Assistant Professor of Physiology, University of California, Berkeley.

The tuition fee for the complete course, including laboratory training, is $350.00. Tuition fee for the lecture series alone is $100.00. Enrollment in this course is limited, and applicants must present biographical data for approval by a Committee on Admissions.

Further information concerning housing facilities, etc., will be available upon request. All communications should be addressed to S. J. Weinberg, M.D., Head of Postgraduate Instruction, Medical Extension, University of California, Los Angeles 24, California.

CENTRAL OHIO RADIOLOGICAL SOCIETY

At a recent meeting of the Central Ohio Radiological Society, completing its second year, Dr. Thurman R. Fletcher was elected President and Dr. Paul D. Meyer Secretary-Treasurer. A number of interesting talks had been given at the various meet-

ings held during the year by guest speakers including Dr. Harry M. Weber of the Mayo Clinic, Dr. Samuel Brown, Dr. Brent Wayman and Dr. Ben Felson, all of Cincinnati, and Dr. Merthyn A. Thomas of Cleveland.

NORTHERN CALIFORNIA RADIOLOGICAL CLUB

The Northern California Radiological Club has been organized for a period of one year and meets at dinner the last Monday in every second month except June, July and August. The next meeting will be held on September 27, 1948. The Secretary of the Club is Dr. Charles E. Grayson, Medico-Dental Building, Sacramento 14, California.

OKLAHOMA STATE RADIOLOGICAL SOCIETY

The Oklahoma State Radiological Society held its meeting on Mary 17, 1948, at the Skirvin Hotel, Oklahoma City, Oklahoma. The guest at the meeting was Dr. L. H. Garland, of San Francisco. The newly elected officers of the Society are: *President*, Dr. P. E. Russo; *Vice-President*, Dr. H. B. Yagol; *Secretary-Treasurer*, Dr. W. E. Brown.

TENNESSEE RADIOLOGICAL SOCIETY

At the recent annual meeting of the Tennessee Radiological Society Dr. A. N. Arneson, of St. Louis, and Mr. Mac F. Cahal, Executive Secretary of the American College of Radiology were guests. The following officers were elected for the coming year: *President*, Dr. Franklin B. Bogart, Chattanooga; *Vice-President*, Dr. Herbert Francis, Nashville; and *Secretary-Treasurer*, Dr. J. Marsh Frère, Chattanooga.

To the Editor:

Since the publication of the paper "Two Danish Photofluorographic Cameras of the Original Schmidt Type," in the March, 1948, issue of the American Journal of Roentgenology and Radium Therapy, our attention has been called to the fact that Dr. Helge Christensen of Copenhagen and not the Danish engineer Helm, was responsible for the initial work involved in the production of the cameras described in the paper. Dr. Christensen has informed us that his work on the application of Schmidt optics to photofluorography began in 1938 and it was not until later in 1940 that Mr. Helm, under the direction of Dr. Christensen, became actively engaged in photofluorographic camera development.

We would like to bring this information to the attention of your readers so that the record on these fundamental developments may be clarified.

Russell H. Morgan, M.D.
David M. Gould, M.D.
Willard W. VanAllen, B.Sc.

THE 1949 MEETING OF THE AMERICAN ROENTGEN RAY SOCIETY

Arrangements have been made to hold the Fiftieth Annual Meeting of the American Roentgen Ray Society in San Francisco, California. The dates of the meeting will be September 6, 7, 8 and 9, 1949.

PRELIMINARY PROGRAM

FORTY-NINTH ANNUAL MEETING OF THE AMERICAN ROENTGEN RAY SOCIETY

The Forty-ninth Annual Meeting of the American Roentgen Ray Society will be held at the Palmer House, Chicago, Illinois, on September 14, 15, 16, and 17 1948.

The Executive Council will meet at noon on Sunday, September 12.

The annual Golf Tournament for the Willis F. Manges Trophy will he held on Monday, September 13, at the Bunker Hill Golf Club, Niles, Illinois.

The Caldwell Lecture will be given on Wednesday evening, September 15, and the Annual Banquet will be held on Thursday evening, September 16.

The Instruction Courses will begin at 8:30 A.M. each day of the meeting, and elsewhere in this issue will be found the detailed plan of the courses.

The Scientific program has been tentatively arranged as follows:

Tuesday, September 14, 1948

8:30 A.M. Instruction Courses.

9:30 A.M. Study of Scientific and Technical Exhibits.

10:30 A.M. Call to Order, Forty-ninth Annual Meeting, J. Bennett Edwards, M.D., President.

Installation of the President-Elect, Lawrence Reynolds, M.D., Detroit, Michigan, by President Edwards and the Chairman of the Executive Council, Vincent W. Archer, M.D., Charlottesville, Va.

Inaugural Address: President Lawrence Reynolds, M.D.

11:30 A.M.

Paper No.

1. Round Table Discussion. Bronchogenic Carcinoma. William M. Tuttle, M.D., Detroit, Michigan, John R. McDonald, M.D., Rochester, Minnesota, William E. Adams, M.D., Chicago, Illinois (all by invitation), Eldwin R. Witwer, M.D., Detroit, Michigan, and Leo G. Rigler, M.D., Minneapolis, Minnesota.

2:00 P.M.

2. Symposium on the Diagnostic, Roentgenographic and Surgical Aspects of Congenital Heart Disease.

The Diagnosis of Congenital Pulmonary Stenosis and Other Important Congenital Cardiac Defects. Stanley Gibson, M.D., Chicago, Ill. (by invitation);

Venous Catheterization in Congenital Heart Disease. Lewis Dexter, M.D., Boston, Mass. (by invitation);

Roentgenographic Methods in the Diagnosis of Congenital Heart Disease other than by Angiocardiography. Edward B. D. Neuhauser, M.D., Boston, Mass. (by invitation);

Interpretation of Normal Cardiovascular Angiograms with a Discussion of Common Errors. Marcy L. Sussman, M.D., New York, N.Y.;

Congenital Cardiovascular Defects which are Demonstrable by Angiocardiography. Robert N. Cooley, M.D., and Robert D. Sloan, M.D., Baltimore, Md. (both by invitation);

The Automatization of Roentgenographic Technique in Cardiovascular and Angiographic Examinations by the Tautograph. Wendell G. Scott, M.D., St. Louis, Mo.;

The Surgical Treatment of Congenital Pulmonic Stenosis. C. Rollins Hanlon, M.D. and Alfred Blalock, M.D., Baltimore, Md. (both by invitation).

Discussion by Merrill C. Sosman, M.D., Boston, Mass., and Willis J. Potts, M.D., Chicago, Ill. (by invitation).

4:30 P.M. Executive Business Session of the Society.

Wednesday, September 15, 1948

8:30 A.M. Instruction Courses.

10:30 A.M. Study of Scientific and Technical Exhibits.

11:00 A.M.

3. Symposium on Considerations in the Diagnosis and Treatment of Diseases of the Chest, Emphasizing the Value of Group Consultation. Julian Johnson,

M.D., Simon Leopold, M.D., Joseph Atkins, M.D., Julius Comroe, M.D. (all by invitation), Robert P. Barden, M.D., Philadelphia, Penna.

Moderator: Eugene P. Pendergrass, M.D., Philadelphia, Penna.

2:00 P.M.

4. Medical and Roentgenological Aspects of Mass Chest Surveys. A. C. Christie, M.D., Washington, D.C.

Discussion by W. Edward Chamberlain, M.D., Philadelphia, Penna.

5. Cryptococcosis (Torulosis) of Bones. Vincent P. Collins, M.D. (by invitation).

Discussion by Harry M. Weber, M.D., Rochester, Minn.

6. The Fate of Oil Particles in the Lung and Their Relationship to the Development of Bronchiogenic Carcinoma: A Roentgenological and Pathological Study. L. R. Sante, M.D., St. Louis, Mo.

Discussion by John R. McDonald, M.D., Rochester, Minn. (by invitation).

7. Hemosiderosis of the Lung due to Mitral Disease: A Report of Six Cases Simulating Pneumonoconiosis. Eugene P. Pendergrass, M.D., Edwin L. Lame, M.D. (by invitation), and Herman W. Ostrum, M.D. (by invitation), Philadelphia, Penna.

Discussion by George LeRoy, M.D., Chicago, Ill. (by invitation).

8. The Role of Nitrogen Mustard as an Adjunct to Roentgen Therapy of Malignant Diseases. Bernard Roswit, M.D., Bronx, N.Y. (by invitation).

Discussion by Traian Leucutia, M.D., Detroit, Mich.

3:30 P.M.

9. Symposium on The Intensification of the Roentgenoscopic Screen.

Present Day Roentgenoscopes and Their Deficiencies. W. Edward Chamberlain, M.D., Philadelphia, Penna.

Fundamental Limitations of Screen Intensifying Systems. Ralph E. Sturm, M.D., Baltimore, M.D. (by invitation).

A New Image Tube for Brightening the Roentgenoscopic Screen. John W. Coltman, Ph.D., East Pittsburgh, Penna. (by invitation).

Clinical Potentialities of Screen Intensification. Russell H. Morgan, M.D., and John F. Roach, M.D. (by invitation), Baltimore, Md.

Discussion by Paul C. Hodges, M.D., Chicago, Ill., Robert J. Moon, Ph.D., Chicago, Ill. (by invitation), and Fred J. Hodges, M.D., Ann Arbor, Michigan.

Wednesday Evening, September 15, 1948

Eight-Thirty O'Clock

The Caldwell Lecture

B. R. Kirklin, M.D.

Chief of the Section of Roentgenology, Mayo Clinic;

Director of the Division of Radiology and Professor of Radiology,

Mayo Foundation Graduate School University of Minnesota, Rochester, Minnesota

"Graduate Education in Roentgenology"

Introduction—Lyell C. Kinney, M.D., San Diego, California

Thursday, September 16, 1948

8:30 A.M. Instruction Courses.

9:30 A.M. Study of Scientific and Technical Exhibits.

10:30 A.M.

10. Symposium on Radiobiology.

Findings on Total Body Radiation from Nuclear Sources. Shields Warren, M.D., Washington, D.C. (by invitation).

Recent Developments in the Study of Radiation Effects on the Hematopoietic System. Leon O. Jacobson, M.D., Chicago, Ill. (by invitation).

The Effect of Ionizing Radiations on Enzymes and Proteins. E. S. Guzman Barron, M.D., Chicago, Ill. (by invitation).

Radiobiological Additivity of Various Ionizing Radiations. Raymond E. Zirkle, Ph.D., Chicago, Ill.

Some Biologicl Effects of Long Continued Irradiation. Egon Lorenz, Ph.D., Bethesda, Md. (by invitation).

2:00 P.M.

10. Symposium on Radiobiology (concluded).

The Metabolic Properties of the Fission Products and Actinide Elements. Joseph G. Hamilton, M.D., Berkeley, Calif. (by invitation).

One unnanounced paper.

The Influence of Radiation Exposure on Length of Life of Laboratory Animals. Robert D. Boche, Ph.D., Chicago, Ill. (by invitation).

Discussion by Edith H. Quimby, M.A., Sc.D., New York, N.Y., and Paul Aebersold, Ph.D., Oak Ridge, Tenn. (by invitation).

3:00 P.M.

11. Dosimetry of Ionizing Particle, G. Failla, D.Sc., and H. H. Rossi, Ph.D. (by invitation), New York, N.Y.
12. Problem of Dosage Measurements for Radiations Above 1 Mev. Lauriston Sale Taylor, Ph.D., Washington, D.C.
13. Techniques for Application of the Betatron to Therapy. Donald W. Kerst, Ph.D., Henry Quastler, M.D., G. M. Almy, Ph.D., and the Betatron Staff, Physics Department, University of Illinois, Urbana, Ill. (all by invitation).

Discussion of above three papers by Kenneth E. Corrigan, Ph.D., Detroit, Mich.

14. Malignant Degeneration of Benign Giant Cell Tumor of Bone. Traian Leucutia, M.D., and James C. Cook, M.D. (by invitation), Detroit, Mich.

Discussion by F. A. Chandler, M.D., Chicago, Ill. (by invitation).

15. Cancer of the Lip. Bernard P. Widmann, M.D., Philadelphia, Penna.

Discussion by Edward L. Jenkinson, M.D., Chicago, Ill.

4:30 P.M. Executive Business Session of the Society.

Thursday Evening, September 16, 1948

Seven-Thirty O'Clock
Annual Banquet

Friday, September 17, 1948

8:30 A.M. Instruction Courses.

10:30 A.M. Study of Scientific and Technical Exhibits.

11 00 A.M.

16. Relative Incidence of Bone Lesions, Including Fractures. Sherwood Moore, M.D., Saint Louis, Mo.
17. The Roentgen Examination of the Cervical Spine. Joseph C. Bell, M.D., Louisville, Ky.

Discussion of above two papers by Maurice M. Pomeranz, M.D., New York, N.Y.

18. The Relation of Therapeutic Radiology to Clinical Medicine. A. U. Desjardins, M.D., Rochester, Minn.

Discussion by James T. Case, M.D., Chicago, Ill.

19. Intravenous Urography in the Study of Vesical Neck Obstruction. W. J. Engel, M.D., Cleveland, Ohio. (by invitation).
20. Deformities of the Bladder Secondary to Ureteral Stone. Harold O. Peterson, M.D., and Barnard Hall, M.D., Saint Paul, Minn. (both by invitation).

Discussion of above two papers by Vincent J. O'Conor, M.D., Chicago, Ill. (by invitation).

21. The Early Diagnosis of Gastric Cancer by Photofluorography. John F. Roach, M.D., Robert D. Sloan, M.D. (both by invitation), and Russell H. Morgan, M.D., Baltimore, Md.

Discussion by Sherwood Moore, M.D., Saint Louis, Mo.

2:00 P.M.

22. The Occurrence of Gastric Ulcer in Diaphragmatic Hernia. Glenn F. Miller, M.D. (by invitation), and Howard P. Doub, M.D., Detroit, Mich.
23. Gastrointestinal Food Hypersensitivity as Shown by the Roentgen Ray. E. J. Tallant, M.D., Frederick Urbach, M.D., and Hugh A. O'Neill, M.D., Philadelphia, Penna. (all by invitation).
24. A Rapid Method of Roentgenologic Examination of the Small Intestine. Sydney Weintraub, M.D., and Robert G. Williams, M.D., New York, N.Y. (both by invitation).

Discussion of above three papers by Ross Golden, M.D., New York, N.Y.

25. Subacute (Pseudotuberculous) Thyroiditis and Its Treatment. John D. Osmond, Jr., M.D. (by invitation), and U. V. Portmann, M.D., Cleveland, Ohio.

Discussion by Hugh F. Hare, M.D., Boston, Mass.

26. Some Partial and Complete Obstructions of the Respiratory Tract in the Newborn due to Tracheobronchial

Malformations. W. A. Evans, M.D., Detroit, Mich.

Discussion by Vincent W. Archer, M.D., Charlottesville, Va.

27. The Time Factor in Cerebral Angiography and the Automatic Seriograph. J. M. Sanchez-Perez, M.D. (by invitation), and R. A. Carter, M.D., Los Angeles, Calif.

Discussion by John F. Holt, M.D., Ann Arbor, Mich. (by invitation).

28. Placental Visualization by "Soft Tissue" Roentgenography. Paul A. Bishop, M.D., Philadelphia, Penna.

Discussion by E. Walter Hall, M.D., Detroit, Mich.

29. The Angiocardiographic Diagnosis of Syphilitic Aortitis. Israel Steinberg, M.D., Charles Dotter, M.D., George Peabody, M.D., George Reader, M.D., L. Heimhoff, M.D., and Bruce Webster, M.D., New York, N.Y. (all by invitation).

Discussion by March L. Sussman, M.D., New York, N.Y.

AMERICAN ROENTGEN RAY SOCIETY

SECTION ON INSTRUCTION

HARRY M. WEBER, M.D., *Director*

Titles and Abstracts of Courses Offered

Forty-Ninth Annual Meeting

Palmer House, Chicago, Illinois

September 14–17, 1948

President-Elect Reynolds, with the approval of the Executive Council, has directed that the Section on Instruction be continued for the 1948 annual meeting. He has arranged his program so that the Instruction Courses will be given between the hours of 8:30 A.M. and 9:30 A.M. on Tuesday and Thursday, and 8:30 A.M. and 10:30 A.M. on Wednesday and Friday. No other official activity will be scheduled during these hours, which will permit everyone at the meeting to attend the Instruction Courses each morning.

The Section on Instruction presents for 1948:

1. The Symposium on Radioactive Isotopes (Courses 101 to 105), with a faculty of five instructors, and covering five periods.

2. Two Special Courses, one on The Preparation and Presentation of Medical Papers (S-1), and one on Practical Roentgenography (S-2), with a faculty of two instructors, and covering five periods.

3. Six special Sequential Courses on Diagnostic Roentgenology (Courses "A" to "F") with a faculty of seven instructors, and covering thirteen periods.

4. Six single-period courses (201–206) on Radiation Physics, with a faculty of five instructors, and covering six periods.

5. Eleven single-period courses (301 to 311) on Therapeutic Radiology, with a faculty of eleven instructors, and covering eleven periods.

6. Twenty-one single-period courses (401 to 420) on Diagnostic Roentgenology, with a faculty of nineteen instructors, and covering twenty-one periods.

GENERAL INFORMATION

The Faculty

Louie T. Austin, D.D.S., Associate Professor of Dental Surgery, Mayo Foundation, University of Minnesota; Dental Surgeon and Head of Section on Dental Surgery, Mayo Clinic, Rochester, Minnesota.

Carl B. Braestrup, Senior Physicist, Department of Hospitals, New York City; Associate Professor of Radiology, New York University and Columbia University, New York, New York.

Ralph S. Bromer, M.D., Radiologist, Children's Hospital, Philadelphia, Pennsylvania, and The Bryn Mawr Hospital, Bryn Mawr, Pennsylvania; Clinical Professor of Radiology, Graduate School of Medicine, University of Pennsylvania, Philadelphia, Pa.

Arthur E. Childe, M.D., Radiologist, Children's Hospital of Winnipeg; Associate Radiologist, Winnipeg General Hospital, Winnipeg, Manitoba, Canada.

K. E. Corrigan, Ph.D., Director, Research Division, Harper Hospital, Detroit, Michigan.

Lilian Donaldson, M.D., Assistant Professor of Roentgenology, University of Chicago, Chicago, Illinois.

Howard P. Doub, M.D., Roentgenologist, Henry Ford Hospital, Detroit, Michigan.

Theodore P. Eberhard, Assistant Professor of Radiology, Jefferson Medical College and Hospital, Philadelphia, Pennsylvania.

Edwin C. Ernst, M.D., Director, Radiological Department, Barnard Free Skin and Cancer Hospital, Saint Louis, Missouri.

Robert E. Fricke, M.D., F.A.C.R., Associate Professor of Radiology, Mayo Foundation, University of Minnesota; Consultant on Radium Therapy, Mayo Clinic, Rochester, Minnesota.

Arthur W. Fuchs, Medical Division, Eastman Kodak Company, Rochester, New York.

Ross Golden, M.D., Professor of Radiology, College of Physicians and Surgeons, Columbia University; Director of the Radiological Service, Presbyterian Hospital, New York, New York.

C. Allen Good, M.D., M.S. in Radiology. Assistant Professor of Radiology, Mayo Foundation, University of Minnesota; Radiologist, Mayo Clinic, Rochester, Minnesota.

Joseph G. Hamilton, B.S., M.D., Professor of Medical Physics, University of California, Los Angeles, California.

H. F. Hare, M.D., Radiologist, Lahey Clinic, Boston, Massachusetts.

Richard M. Hewitt, M.A., M.D., Assistant Professor of Medical Literature, Mayo Foundation, University of Minnesota; Editor and Head of Division of Publications, Mayo Clinic, Rochester, Minnesota.

Fred Jenner Hodges, M.D., Professor of Roentgenology, University of Michigan, Ann Arbor, Michigan.

John F. Holt, M.D., Associate Professor of Roentgenology, University of Michigan, Ann Arbor, Michigan.

Harold W. Jacox, M.D., Professor of Radiology, College of Physicians and Surgeons, Columbia University; Chief of Radiotherapy Division of Radiological Service, Presbyterian Hospital, New York, New York.

B. R. Kirklin, M.D., F.A.C.P., F.A.C.R., Professor of Radiology, Mayo Foundation, University of Minnesota; Radiologist and Head of Section on Radiology, Mayo Clinic, Rochester, Minnesota.

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Maurice Lenz, M.D., Professor of Clinical Radiology, Columbia University, New York; Consultant Radiotherapist to the Manhattan Eye, Ear and Throat Hospital, Montefiore Hospital and Presbyterian Hospital, New York, New York.

Traian Leucutia, M.D., Director, Department of Radiotherapy and Associate Radiologist, Harper Hospital, Detroit, Michigan.

A. S. Macmillan, M.D., Radiologist, Massachusetts Eye and Ear Infirmary, Boston, Massachusetts.

Charles L. Martin, M.D., Professor of Radiology, Southwestern Medical College, Dallas, Texas.

Edward B. D. Neuhauser, M.D., Radiologist, Infants' and Children's Hospitals; Associate in Radiology, Harvard Medical School, Boston, Massachusetts.

W. J. Oosterkamp, M.D., Research Laboratory of N. V. Philips Gloilampenfabrieken, Eindhoven, Holland.

Lester W. Paul, M.D., Professor of Radiology, University of Wisconsin, Madison, Wisconsin.

Carleton B. Peirce, A.B., M.Sc., M.D., F.A.C.P., Radiologist-in-Chief, Royal Victoria Hospital; Chairman, Department of Radiology, Faculty of Medicine, McGill University, Montreal, Quebec, Canada.

Harold O. Peterson, M.D., Clinical Associate Professor of Radiology, University of Minnesota, Minneapolis, Minnesota; Radiologist to Miller Hospital and Children's Hospital, Saint Paul, Minnesota.

U. V. Portmann, M.D., Director of Therapeutic Radiology, Cleveland Clinic Foundation, Cleveland, Ohio.

Edith H. Quimby, Sc.D., Associate Professor of Radiology (Physics), College of Physicians and Surgeons, Columbia University, New York, New York.

W. S. Randall, A.B., M.D., Department of Pathology, Ochsner Clinic and Tulane University; Pathologist, Foundation Hospital, New Orleans, Louisiana.

Edward H. Reinhard, M.D., Assistant Professor of Medicine and Assistant Professor of Radiology, Washington University School of Medicine, Saint Louis, Missouri.

Leo G. Rigler, M.D., Professor of Radiology, University of Minnesota, Minneapolis, Minnesota.

L. R. Sante, M.D., Professor of Radiology and Director of Department, Saint Louis University School of Medicine, Saint Louis, Missouri.

Richard Schatzki, M.D., Mount Auburn Hospital, Cambridge, Massachusetts.

Wendell G. Scott, M.D., Associate Professor of Clinical Radiology, Washington University School of Medicine; Associate Director, Mallinckrodt Institute of Radiology, Saint Louis, Missouri.

William Snow, M.D., Roentgenologist-in-Charge, Harlem Hospital; Director of Radiology, Bronx Hospital, New York, New York.

Paul C. Swenson, M.D., Professor of Radiology, Jefferson Medical College, Philadelphia, Pennsylvania.

Robert B. Taft, M.D., B.S., M.A., Professor of Radiology, Medical College of State of South Carolina, Charleston, South Carolina.

Lauriston S. Taylor, A.B., Chief, X-ray Section, National Bureau of Standards, Washington, D. C.

J. L. Weatherwax, M.A., Physicist, American Oncologic Hospital, Assistant Professor of Radiotherapeutic Physics, Graduate School of Medicine, University of Pennsylvania. Philadelphia, Pennsylvania.

Bernard P. Widmann, M.D., Chief Radiologist, Philadelphia General Hospital; Chairman of the Graduate School in Radiology, University of Pennsylvania, Philadelphia, Pennsylvania.

Marvin M. D. Williams, M.S., Ph.D., Associate Professor of Biophysics, Mayo Foundation, University of Minnesota; Biophysicist, Mayo Clinic, Rochester, Minnesota.

George M. Wyatt, M.D., The Radiological Clinic of Doctors Groover, Christie and Merritt, Washington, D. C.

Barton R. Young, M.D., Professor of Radiology Temple University, Philadelphia, Pennsylvania.

Conference Periods

Tuesday, Wednesday, Thursday and Friday mornings

First period.....8:30– 9:20 A.M.
Second period.....9:30–10:30 A.M.

Location

All courses will be given in rooms 705, 706, 731, 732, 733, 734, 736, 738, 740, 744, located on the seventh floor of the Palmer House. Full information may be obtained at the general registration desk which will be located on the Fourth Floor.

Code

The periods of instruction will be designated with code letters and numbers as follows:

T-1 Tuesday, single period.....8:30– 9:30 A.M.
W-1 Wednesday, first period.....8:30– 9:20 A.M.
W-2 Wednesday, second period...9:30–10:30 A.M.
Th-1 Thursday, single period.....8:30– 9:30 A.M.
F-1 Friday, first period.....8:30– 9:20 A.M.
F-2 Friday, second period.....9:30–10:30 A.M.

(Familiarity with this code will help to avoid confusion)

How to Register and Obtain Tickets for the Instruction Courses

Admission to the Instruction Courses will be by ticket only.

Following the list of titles and abstracts there is a general order sheet. First, second and third choices for each period should be selected carefully and indicated on the order. The rooms in which the courses will be given are not large, which places a limitation on the number of persons who will be able to attend individual courses. It is estimated that the number who can attend will range between thirty-five and fifty. If the directions given on the order sheet are followed explicitly, errors in completing reservations will be minimized.

Persons requesting registration in one or more of the Sequential (continuous) Courses (S-2, A, B, C, D, E, F) should indicate second and third choices of single-period courses as substitutes for each period—this is to avoid disappointment should the Sequential Courses be filled when the order is received.

It is possible for one to attend only six periods of instruction, so the condensed schedule given on the last pages of this program should be consulted with care when registering and ordering tickets.

Reservations will be made in the order in which the order forms are received. Those who are not members of the American Roentgen Ray Society will be charged the nominal fee of $1.00 per period of instruction, or a maximal fee of $5.00 for five or more periods. Full-time graduate students in Radiology will be admitted without fee.

Previous to September 4, 1948, the order forms should be sent to the Director, Dr. Harry M Weber, Rochester, Minnesota. After September 4, the orders should be

sent directly to Dr. Harry M. Weber, Palmer House, Chicago, Illinois.

In case the courses are not filled by the time of the meeting, tickets will be available at the registration desk on Sunday, September 12, and thereafter during the meeting.

Holders of Tickets

Those who do not have the proper ticket for the assigned course will not be permitted to enter the room. Pages will be in attendance in each conference room to collect tickets.

DESCRIPTION OF COURSES

I. The Symposium on Radioactive Isotopes

COURSE 101

Room 705 **Period: T-1**

M. M. D. WILLIAMS, Ph.D.,
Rochester, Minn.

The Nature and Production of Radioisotopes

The difference between stable and radioactive isotopes and the methods of producing them will be discussed briefly. Most of the discussion will be on the physical characteristics of radioisotopes: rates of decay, half-life, types of radiation emitted and the properties of the radiations. Those characteristics of importance to a radiologist who may use radioisotopes will be stressed. Some of the more important problems relating to the protection of personnel working with radioisotopes will be mentioned.

COURSE 102

Room 705 **Period: W-1**

EDITH H. QUIMBY, Sc.D.,
New York, N. Y.

Dosage Problems in the use of Radioactive Isotopes

Discussion of physical characteristics (activity, half-life, type and energy of radiation).

Tissue dosage determinations, when introduced into the body as chemical compounds. Influence of rate of decay, elimination, local concentration. Dangers in the use of radioactive isotopes internally administered. Protection of personnel. Dosage data and charts will be presented.

COURSE 103

Room 705 **Period: Th-1**

JOSEPH G. HAMILTON, M.D.,
Berkeley, Calif.

The Clinical Applications of Radioactive Iodine

Radioactive iodine has been employed as a therapeutic agent for the treatment of Graves' disease for a number of years. The initial clinical trials of this agent were made in 1941. Since then an ever-increasing number of patients with hyperthyroidism have been treated with radio-iodine. At the present time more than a dozen large medical centers are pursuing active programs using radio-iodine for this purpose. Coincidentally, considerable effort has been directed toward evaluating the potential use of radio-iodine in the treatment of malignant disease of the thyroid. Here the picture has been rather discouraging when compared to the relatively successful results obtained with radio-iodine therapy for hyperthyroidism. A review will be presented of the status of radio-iodine in the treatment of these two thyroid disorders.

COURSE 104

Room 705 **Period- F-1**

K. E. CORRIGAN, Ph.D.,
Detroit, Mich.

The Practical Use of Tracer Isotopes

The classes of tracer isotopes applicable to medical problems will be presented and their specific applications discussed in some detail. The considerations which control the choice of the proper isotope for a particular problem and the results to be expected will be presented.

II. SEQUENTIAL COURSES

COURSE A
(2 periods)

Room 736 **Periods: Th-1; F-1**

RALPH S. BROMER. M.D.,
Philadelphia, Pa.

The Differential Diagnosis of Skeletal Changes Occurring in Diseases of Infants and Children

The time allotted will be spent in discussing the differential roentgen diagnosis of skeletal changes occurring in diseases of infancy and childhood. All such diseases cannot be included in the time available for the course. Case material will be chosen from the following list: congenital syphilis, rickets, in-

fantile scurvy, tuberculosis, lead poisoning, the blood dyscrasias, xanthomatosis and allied conditions, osteogenesis imperfecta, achondroplasia, multiple enchondromata, multiple cartilaginous exostoses, metastases caused by neuroblastoma, osteochrondritis and endocrine disturbances. Wherever possible the early roentgen changes will be emphasized. The question of differential diagnosis will be approached from the standpoint of the predisposition of the various diseases to affect certain bones or certain areas of individual bones. Thus in the case of the long bones, differential roentgen signs of the disease processes in the epiphysis, the diaphysis, the metaphysis, the periosteum, cortex, etc., will be given in detail.

COURSE 105

Room 705 **Period: F-2**

EDWARD H. REINHARD, M.D.,
St. Louis, Mo.

The Treatment of Blood Dyscrasias and Malignant Lymphomas with Radioactive Phosphorus, Radioactive Sodium, and Colloidal Preparations of Various Radioactive Isotopes

Approximately 300 patients with polycythemia vera, various types of leukemia, and malignant lymphomas have been treated with radioactive phosphorus at the Mallinckrodt Institute of Radiology in St. Louis. The method of treatment and the clinical results in these patients will be discussed. Complete hematologic and almost complete symptomatic remissions can be produced with P^{32} in the vast majority of patients with polycythemia vera, and remission from a single course of treatment may last for some six months to three or four years or even longer. Radioactive phosphorus has been found to be of no value in the treatment of acute or subacute leukemia, but patients with chronic myelogenous and chronic lymphatic leukemia can be controlled very satisfactorily by this form of treatment. The theoretical advantages of radioactive phosphorus over roentgen rays are: (1) the radioactive material is taken up collectively by the bone marrow and, to a certain extent, the lymph nodes and spleen; (2) with radioactive phosphorus, the radiation to which the patient is exposed is of low intensity but prolonged over a considerable period of weeks. The theoretical advantages of this will be discussed; (3) radiation sickness is unknown with P^{32}.

Isotopes of sodium have been tried in the treatment of leukemia in other laboratories. Na^{24}, which is the isotope that has been commonly employed, has a half-life of 14.8 hours and emits both beta rays and gamma rays. This element is distributed evenly to the tissue fluids throughout the body and there is no selective uptake by bone marrow or lymphatic tissue. However, chronic leukemia will respond favorably to radioactive sodium therapy just as it responds to general body roentgen irradiation. Radioactive sodium is easy to prepare and is inexpensive.

Colloidal suspensions of various radioactive isotopes have been administered intravenously to experimental animals and the distribution of the material studied. It has been found that the colloidal particles are taken up selectively by the reticuloendothelial cells of the body. The highest concentrations are found in the liver, spleen, and bone marrow. These studies suggested the possibility of using some such preparation in the treatment of Hodgkin's disease, reticulum cell sarcoma, and other tumors arising in the reticuloendothelial system. Colloidal suspensions of radioactive chromic phosphate, radioactive iron phosphate, radioactive manganese, and radioactive gold have been employed in various laboratories in the treatment of the malignant lymphomas. In some instances encouraging results have been obtained.

COURSE B

(3 periods)

Room 738 **Periods: W-1; Th-1; F-1**

ROSS GOLDEN, M.D.,
New York, N. Y.

Roentgenology of the Small Intestine

Tuesday

- Technique
- Normal small intestine
  - Anatomy
  - Physiology
- Indications for small intestine study
- Diverticula
- Disturbances in physiology
  - Emotion
  - Vagotonia
  - Multiple peritoneal adhesions
- Developmental anomalies
  - Internal hernia
  - Congenital diaphragm
- Effect of disease of the mesentery
  - Localized
  - Generalized
    - Lymphoblastoma
    - Sclerosing mesenteritis

Wednesday

- The "Deficiency Pattern"
  - Vitamin deficiency states
  - Hypoproteinemia
  - Biliary tract disease
  - Pancreatic disease
- Allergy
- Inflammations
  - Tuberculous
  - Non-tuberculous
    - Sclerosing regional enteritis
    - Non-sclerosing regional enteritis

Thursday

Neoplasms
- Benign
- Malignant
  - Carcinoma and carcinoid
- Lymphosarcoma
  - Localized
  - Diffuse

Benign ulcer

Ileus
- Diagnosis by 3 position abdominal films
  - Paralytic
  - Mechanical
  - Mesenteric vascular occlusion
- The Miller-Abbott tube
  - Technique of insertion
  - Deflation
  - Injection of barium for
    1. Localization
    2. Demonstration of type of obstruction
- Complications

COURSE C

(2 periods)

Room 706 **Periods: Th-1; F-1**

CARLETON B. PEIRCE, M.D.,
Montreal, Quebec

Bronchography

The first period will be devoted to the gross and roentgen anatomy of the thoracic viscera, the bronchovascular pattern, the distribution of the branches of the bronchial tree with special relation to the segments of the lungs and nomenclature.

The second period will include consideration of the various techniques for bronchographic examination and the interpretation of the resulting bronchograms.

COURSE D

(2 periods)

Room 731 **Periods: W-1; W-2**

LEO G. RIGLER, M.D.,
Minneapolis, Minn.

Roentgen Manifestations of Bronchogenic Tumors

The roentgen findings obtained with various types of bronchogenic tumors will be discussed with particular reference to the following:

1. The possibilities and limitations of roentgen diagnosis of bronchogenic tumors.
2. The roentgen delineation of the tumor mass.
3. Inflammatory changes associated with bronchogenic tumors.
4. The roentgen evidences of bronchial obstruction such as emphysema, atelectasis, and secondary inflammatory changes.
5. The demonstration of the bronchial tumor by bronchography and planigraphy.
6. The special findings in bronchial adenoma.

Diagrams and reproductions of roentgenograms will be demonstrated to illustrate these various findings.

COURSE E

(2 periods)

Room 733 **Periods: W-1; W-2**

WILLIAM SNOW, M.D.,
New York, N. Y.

Roentgen Study of Pregnancy

Part 1 (W-1): The technique of roentgenography.

Part 2 (W-2): A simplified method of analyzing the roentgenograms. Measurements. The architecture of the female pelvis. Demonstration will be made with lantern slides and with original roentgenograms.

COURSE F

(2 periods)

Room 731 **Periods: Th-1; F-1**

GEORGE M. WYATT, M.D.,
Washington, D.C., and
W. S. RANDALL, M.D.,
New Orleans, La.

Benign and Malignant Lesions of Bone

This material is largely selected from the cases admitted to the Walter Reed General Hospital in its capacity as a tumor center during World War II. Lantern slides include the roentgenographic, gross, and microscopic appearance of the various lesions.

Among the conditions to be considered are osteomyelitis, osteoid osteoma, fibrous dysplasia, eosinophilic granuloma, giant cell tumor, lymphoma, chondrosarcoma, osteogenic sarcoma, Ewing's tumor, neuroblastoma, and myeloma.

Attention will be directed to correlation of the roentgen appearance and gross pathology and to differential diagnosis of benign and malignant lesions. Therapeutic measures will also be discussed.

III. SPECIAL COURSES

COURSE S-1

Room 731 **Period: T-1**

RICHARD M. HEWITT, M.D.,
Rochester, Minn.

Suggestions Concerning the Writing and Presentation of Medical Papers

1. Form of the medical manuscript.
2. Devices which aid toward orderly arrangement.
2. Some typical erroneous expressions.
4. The tabular or textual stereoptican slide.

COURSE S-2

(4 periods)

Room 734 **Periods: W-1; W-2; F-1; F-2**

ARTHUR W. FUCHS,
Rochester, N. Y.

Influence of Exposure Factors on Roentgenographic Quality

The roentgenologist is not so much interested in the occasional excellent roentgenogram as he is in obtaining a consistently uniform series of good quality roentgenograms from day to day. The large number of roentgenograms that must be produced in the modern laboratory demands standardization of exposures so that a reasonable uniformity results. The course will demonstrate a practical approach to the use of exposure factors that affect density and contrast, hence, roentgenographic quality. The subject matter will be generously illustrated with roentgenograms demonstrating the points discussed.

IV. THERAPEUTIC RADIOLOGY

COURSE 301

Room 733 **Period: Th-1**

THEODORE P. EBERHARD, M.D.,
Philadelphia, Pa.

Treatment of Leukemias and Lymphomas

The radiologist must often act as his own hematologist and assume full control of these cases. The armamentarium now includes a large array of substances, such as urethane, aminopterin, methopterin, amfol R, brewer's yeast, nitrogen mustard gas and others. The particular place for each of these and its integration into the scheme of treatment along with roentgen therapy will be discussed.

COURSE 302

Room 706 **Period: F-2**

E. C. ERNST, M.D., St. Louis, Mo.

Practical Concepts of Radiation Treatment of Carcinoma of the Cervix Uteri

SYNOPSIS

(a) *Clinical Management and Preliminary Considerations*
(b) *Indications for Roentgen Therapy:*
   1. Indirect irradiation of the pelvis.
   2. Direct (intravaginal) roentgen-ray applications.
(c) *Essential Tumor Dose Measurement Factors*
(d) *Indications for Radium Therapy:*
   1. Evaluation of the various methods and the intracervical applicators.
   2. Essential minimum requirements for obtaining the ideal uniform distribution of radium radiations.
(e) *Prognostic Factors:*
   1. Tumor grading.
   2. Stage of the disease.
   3. Initial response to preliminary roentgen irradiation.
(f) *Final Discussion Period:*
   Case presentations.
   2. Questions (15 minutes).

ABSTRACT

The practical irradiation management of carcinoma of the cervix will be discussed both from the standpoint of the institutional tumor clinic and the private office procedure. Although realizing that the radiation treatment standards continue to remain somewhat in a state of flux and that individualization in the application of roentgen rays and radium is a most essential consideration, nevertheless certain fundamental concepts in our routine procedures are most helpful in the management of cancer of the cervix. These and many other practical therapeutic considerations, including external roentgen therapy, intracavity radium and roentgen methods of treatment and the dosage measurement problems, will be discussed and illustrated.

COURSE 303

Room 740 **Periods: F-1**

R. E. FRICKE, M.D., Rochester, Minn.

Radium Therapy for the Less Common Malignant and Non-Malignant Conditions

Much has been written and taught regarding radium therapy for the more usually encountered malignant and inflammatory conditions known to respond to irradiation. However, the radiologist is often confronted with rare lesions which also are sensitive to irradiation. Lesions such as carcinoma of

the penis, Peyronie's disease, cancer of the urethra, chronic lymphedema of the face, cystic hygroma, and other rare diseases, merit discussion. General principles of treatment and technique will be emphasized.

COURSE 304

Room 733 **Period: F-1**

ISADORE LAMPE M.D.,
Ann Arbor, Mich.

Radiation Therapy of Selected Miscellaneous Non-Malignant Conditions

At the University Hospital of the University of Michigan, the practice of the Section on Radiation Therapy includes the treatment of a large heterogeneous group of diseases which are not neoplastic, Of these a number have been selected for discussion of clinical and therapeutic aspects:

Simple inflammations and infections
Acute parotitis
Acute postpartum mastitis
Tuberculous lymphadenitis
"Thymus"
Spondylitis rhizomelique
Myasthenia gravis

COURSE 307

Room 744 **Period: F-2**

T. LEUCUTIA, M.D., Detroit, Mich.

Comparison of 200 kv. and Supervoltage Roentgen Therapy

I. *Physical Aspect.* Supervoltage roentgen therapy differs from the 200 kv. therapy at least on three points:

1. There is an increase in the differential action of the roentgen rays with increasing voltages, whether this action be a direct or indirect function of the quality of the roentgen rays.
2. An increasingly larger physical dose of radiation can be administered with increasing voltages to produce a similar biologic effect, especially skin erythema.
3. The percentage depth dose, in addition to certain other deviations, shows an appreciable increase with higher voltages.

II. *Clinical Aspect.* In estimating the clinical value, one may distinguish between the immediate effect and late results:

1. The immediate effect is superior with supervoltage roentgen therapy in a well selected group of malignant neoplasms: (*a*) due to the fact that because of the above physical factors, the radiation is more homogeneous and efficacious, and (*b*) since a larger total dose can be administered with a lesser damage to the skin.
2. The late results are dependent on a good immediate effect and on a relatively low malignancy index of the irradiated neoplasm, so that the tumor remains local. Five-year statistical data are given.

COURSE 305

Room 733 **Period: T-1**

EUGENE T. LEDDY, M.D.,
Rochester, Minn.

Roentgen Therapy for Carcinoma of the Breast

The theoretical, technical and statistical aspects of the preoperative use of roentgen therapy in cases of carcinoma of the breast will be reviewed briefly. The reasons why this type of therapy is not used at the Mayo Clinic will be presented. For several years, a fairly constant postoperative roentgen technique has been used; its clinical efficacy will be considered in detail.

COURSE 306

Room 706 **Period: T-1**

MAURICE LENZ, M.D.,
New York, N. Y.

Radiotherapy of Ocular Lesions

Radium and roentgen therapy of inflammatory lesions and neoplasms in and about the eye are influenced by the radiosensitivity of the conjunctiva, cornea and lens, and the radioresistance of the retina. In lesions limited to the lid, the globe may be excluded by lead shields. Radiotherapy of various inflammatory and neoplastic diseases of the eye will be discussed in detail.

COURSE 308

Room 706 **Period: W-2**

CHARLES L. MARTIN, M.D.,
Dallas, Texas

Complete Care of Cancer of Mouth and Lip Including Cervical Metastases with Irradiation Alone

A plan for the complete radiological care of all stages of cancer of the mouth and lip will be described. Although both radium and roentgen rays are used, the equipment is relatively inexpensive and the time of treatment is short. Much emphasis will be placed on the intensive irradiation of metastatic cervical glands, using a combined roentgen-ray and interstitial radium technique, which has yielded some very promising results. Detailed descriptions of the procedure used in a number of actual cases have been prepared for presentation.

COURSE 309

Room 733 **Period: F-2**

U. V. PORTMANN, M.D.,
Cleveland, Ohio

Contact Roentgen Therapy for Superficial Lesions

This will be a presentation with Kodachrome slides of cases of epitheliomas, hemangiomas, verruca and similar conditions given contact roentgen therapy. Results will be shown and techniques used for treatment will be described. Some of the difficulties and contraindications of this method will be discussed.

COURSE 310

Room 705 **Period: W-2**

HAROLD W. JACOX, M.D.,
New York, N. Y.

Complications Following Irradiation of the Pelvis

The discussion will include those complications which are general and local, both immediate and late, of slight and serious consequence. Consideration will be given to details of the rate and methods of applying roentgen and radium therapy for pelvic lesions. The various organs involved will be evaluated from the standpoint of their tolerance to irradiation. The mechanism and management of these complications will be considered with a view to avoiding them if possible.

COURSE 311

Room 732 **Period: Th-1**

BERNARD P. WIDMANN, M.D.,
Philadelphia, Pa.

Radiation Therapy in Cancer of the Skin

Technical procedures for the radium and roentgen treatment of cancer of the skin will be reviewed and analyzed in detail. A definite predetermined plan of dosage has been formulated according to the estimated surface area and thickness of the lesion. Special emphasis will be placed on the value of low voltage roentgen rays (100–135 kv.), and a clinical comparison with radium will be made according to a great variety of patterns for single and multiple radium tubes with different sizes of fields, filters and distances. Conclusions will be drawn from a large clinical experience with massive and fractional doses. Determination of the "maximum safe dose," the "minimal effective dose," the daily intensity and the probable best rate of administration will be considered with specific recommendations after a routine experience demonstrating results and skin tolerance.

V. RADIATION PHYSICS

COURSE 201

Room 740 **Period: T-1**

CARL B. BRAESTRUP. Ph.D.,
New York, N. Y.

Common Causes of Radiation Hazards in Radiology

Radiation injuries are due mainly to improper operating procedures, faulty equipment, or inadequate structural shielding.

Operating Procedures: Fracture setting under fluoroscopy has been the cause of most radiation injuries in diagnostic roentgenology. The greatest hazards in therapy are the omission of the filter and incorrect use of ionization instruments.

Equipment: Improvements in roentgen-ray tube design has so increased the available dosage rate that permanent skin injuries may be produced in a few seconds. Roentgen therapy equipment should therefore be provided with accurate means for the control of the dose.

The protection afforded the patient and the fluoroscopist depends largely upon the construction of the fluoroscope. The use of long target-panel distances and adequate filtration reduces materially the exposure to the patient. The dose received by the operator is minimized by proper diaphragming of the useful beam and ample shielding against scattered radiation.

Structural Shielding: The use of protective equipment has often produced a false sense of security, especially if represented as "ray-proof." Obviously, barriers must be provided in any case against the useful beam and scattered radiation. Radiation injuries due to inadequate structural shielding seldom manifest themselves for years when permanent damage has already been done. No roentgen-ray installations, therefore, should be considered safe until so established by radiation measurements.

Radium Therapy: The hazards associated with typical radium and radon applications will be discussed.

COURSE 202

Room (to be announced) **Period Th-1**

W. J. OOSTERKAMP, M.D.,
Eindhoven, Holland

The Dosage Characteristics of Contact Roentgen Therapy Apparatus in Air and Water Phantoms

COURSE 203

Room 740 **Period: Th-1**

ROBERT B. TAFT, M.D.,
Charleston, S. C.

Dosage Measurement from a Clinical Standpoint

The various methods in common use for measuring clinical roentgen-ray dosage will be discussed, and the advantages and disadvantages of each pointed out. The value of the roentgen as a clinical unit will be compared with formerly used units. Pros and cons for the direct dosage measurement on the skin of the patient throughout the treatment time will be given. Air measurements versus skin measurements will be outlined and tables given for backscattering at commonly used wavelengths. Brief mention will be made of methods of determining stray radiation around a laboratory, either medical or industrial. Half of the period will be taken up with the above and round table discussion will follow. Throughout, an earnest effort will be made to keep the matter within the scope of the clinical radiologist who has little knowledge of, or interest in, pure physical measurements. The instructor, having had experience in both clinical and physical work, will attempt to narrow the far-too-wide gap between the clinician and physicist.

COURSE 204

Room 740 **Period: W-1**

LAURISTON S. TAYLOR, Ph.D.,
Washington, D. C.

High Voltage Generators

COURSE 205

Room 740 **Period: W-2**

J. L. WEATHERWAX, M.A.,
Philadelphia, Pa.

Factors Affecting Roentgen-Ray Dosage

Roentgen-Ray Dosage: The effect of radiation quality, focal skin distance, size of field, depth of underlying tissue in the treatment of skin and deep-seated lesions.

Application of isodose charts and tables in determining tumor doses, emphasizing more complete treatment records.

COURSE 206

Room 740 **Period: F-2**

J. L. WEATHERWAX, M.A.,
Philadelphia, Pa.

Factors Affecting Radium Dosage

Basis for expressing radium dosage in gamma roentgens.

Arrangement of radium tubes and needles according to Paterson and Parker curves relating milligram-hours to various lengths and areas of radium applicators to deliver 1,000 gamma roentgens.

Application of Quimby's tables to radium tubes and needles in gamma roentgens.

VI. DIAGNOSTIC RADIOLOGY

COURSE 401

Room 734 **Period: Th-1**

LOUIE T. AUSTIN, D.D.S.,
Rochester, Minn.

Interpretation of the Dental Roentgenogram

The subject will be presented by means of lantern slides of selected dental roentgenograms showing dental abnormalities commonly encountered. The clinical significance of these will be stressed.

COURSE 402

Room 736 **Period: T-1**

ARTHUR E. CHILDE, M.D.,
Winnipeg, Manitoba

The Normal Encephalogram and Ventriculogram
Congenital Abnormalities of the Brain

The roentgen technique of cerebral pneumography will be discussed and the importance of a few simple manipulations of the head during this procedure will be explained. This will be followed by a review of the normal anatomy of the ventricular system, basal cisterns and cortical markings. The pneumographic features of various congenital abnormalities will be shown.

COURSE 403

Room 736 **Period: W-1**

ARTHUR E. CHILDE, M.D.,
Winnipeg, Manitoba

The Pneumographic Diagnosis of Expanding, Contracting and Atrophic Intracranial Lesions

The deformities produced by various types of expanding intracranial lesions will be shown. Encephalography is often used to determine the cause of epileptic seizures in patients who do not suffer from brain tumors, and some examples of atrophic and contracting intracranial lesions will also be illustrated.

COURSE 404

Room 736 **Period: W-2**

LILIAN DONALDSON, M.D.,
Chicago, Ill.

The Early Diagnosis of Gastric Cancer

The topic will be discussed in detail illustrated with

actual roentgenograms projected by means of a mirror system. Common pitfalls of the diagnostic problem will be stressed and methods and interpretations available for avoiding them will be offered.

COURSE 405

Room 744 **Period: T-1**

HOWARD P. DOUB, M.D.,
Detroit, Mich.

Myelography

A general review of myelography will be presented covering the technique, the various steps in its evolution, and the different media which have been employed.

In connection with the application of the procedure to the diagnosis of protruded intervertebral disk, a brief review will be given of the development of the disk, its anatomy and physiology, and the changes incident to senescence. Some clinical aspects of disk protrusion will also be covered.

The diagnosis of tumors of the cord, of obstruction due to spinal tumors with pressure effects on the cord, and of inflammatory processes will also be considered.

COURSE 406

Room 732 **Period: W-1**

C. ALLEN GOOD, M.D.,
Rochester, Minn.

The Small Intestine

All of the lesions commonly encountered in the small intestine will be discussed. Special emphasis will be placed upon the diagnosis of the organic lesions which are amenable to surgical treatment, such as enteritis, Meckel's diverticulum and benign and malignant tumors.

Particular attention will be paid to the roentgenoscopic method of examination and there will be a brief consideration of the clinical indications for a roentgenologic examination of the small intestine.

Lantern slides of roentgenograms and of colored photographs of the pathologic material will be presented.

COURSE 407

Room 732 **Period: F-2**

HUGH F. HARE, M.D.,
Boston, Mass.

Recent Studies on Certain Intracranial Measurements

1. The measurement of the sella turcica in the normal child and adult by the lateral contour method and by the posteroanterior projection. A discussion of the various changes in the sella turcica produced by intrasellar and parasellar lesions.

2. A review of the methods of pineal measurement.

COURSE 408

Room 731 **Period: F-2**

FRED JENNER HODGES, M.D.,
Ann Arbor, Mich.

Intracranial Angiography

The indications for this type of examination will be outlined and the required technical procedures will be discussed. Examples of angiographic results in the examination of various patients typifying the major forms of intracranial abnormality which can be detected by this method will be presented.

Although this is very highly specialized form of roentgen diagnosis with a relatively narrow field of application, the degree of diagnostic accuracy which it brings to neurosurgical problems is not to be overlooked. Even though a radiologist does not employ it himself he should be fully aware of its potentialities.

COURSE 409

Room 734 **Period: T-1**

JOHN F. HOLT, M.D.,
Ann Arbor, Mich.

The Mechanisms of Skeletal Growth

The practicing radiologist, whose day to day activities are necessarily keyed to the clinical level, must on occasion refer to knowledge derived from the basic sciences in order to understand adequately alterations in roentgen appearance which must then be translated into terms of disease. This is particularly true in the case of growing bone, whether the alteration observed is a normal anatomic variation, of which there are many, or an obscure pathologic process which defies immediate classification. By the use of specific examples an attempt will be made in this course to show how a reasonable understanding of the fundamentals underlying osseous development will serve to facilitate roentgenologic interpretation in this particular field.

COURSE 410

Room 738 **Period: F-2**

B. R. KIRKLIN, M.D.,
Rochester, Minn.

Newer Developments in Cholecystography

The cholecystographic diagnosis of tumors of the gallbladder will be discussed in detail, also some newer developments in technique will be presented.

COURSE 411

Room 744 **Period: W-1**

A. S. MACMILLAN, M.D.,
Boston, Mass.

Roentgen Examination of the Sinuses

1. Roentgen examination of the sinuses is a very important part of the diagnosis of pathology in these locations. The rhinologist is dependent upon a correct interpretation of the sinus roentgenograms. The findings should be reported in terms of pathology, and not in the indefinite roentgenological terms so often used. In this presentation, the technique of examination and interpretation will be considered as fully as time will allow.

COURSE 412

Room 744 **Period: Th-1**

A. S. MACMILLAN, M.D.,
Boston, Mass.

Roentgen Examination of the Mastoids

2. The use of chemotherapy and antibiotics has greatly changed the course of infection in the mastoid. Pediatricians and general medical practitioners sometimes feel competent to treat this condition, but too often the treatment is inadequate. The roentgenologic examination of the mastoid is the only dependable source of information. This should be recognized, because mastoiditis is still prevalent. Acute and chronic infections of the mastoid and the complications will be discussed.

COURSE 413

Room 744 **Period: F-1**

A. S. MACMILLAN, M.D.,
Boston, Mass.

3. *The film reading session* will consider conditions met in a hospital devoted to treatment of the sinuses, mastoids and abnormalities of the esophagus. Rare and unusual conditions are often emphasized in a presentation such as this, with failure to give adequate consideration to the more common types of pathology met with every day. This discussion will deal with the more commonly encountered abnormalities in which roentgenologic assistance is sought.

The new projector developed by Doctors Dillon and Murphy which makes it possible to show four original roentgenograms of the sinuses at one time will be used.

COURSE 414

Room 738 **Period: W-2**

EDWARD B. D. NEUHAUSER, M.D.,
Boston, Mass.

The Roentgen Diagnosis of Congenital Cardiovascular Abnormalities Amenable to Surgery

Many forms of congenital malformation of the heart and great vessels, long considered of academic interest only, are now surgically correctible. Recent advances in roentgen diagnosis and in surgical techniques are leading to the recognition of abnormalities which have been overlooked in the past, and have led to the more accurate diagnosis of many malformations whose major features have long been known.

The roentgen features of patent ductus arteriosus, coarctation of the aorta, stenosis of the pulmonary artery, tetralogy of Fallot, Corvisart's complex, double aortic arch, vascular rings constricting the trachea and esophagus, and anomalies of the right subclavian artery and of the innominate vein should be familiar to all roentgenologists. The diagnostic criteria of these malformations will be discussed.

COURSE 415

Room 732 **Period: W-2**

LESTER W. PAUL, M.D.,
Madison, Wisc.

The Roentgenology of the Rheumatic Diseases

This course will include a discussion of the role of roentgen examination in the diagnosis of the various diseases of the joints and periarticular structures. A classification of arthritis suitable for both roentgen and clinical use will be given. The pathologic basis for the changes visualized by roentgen examination will be covered briefly. Major emphasis in the course will be placed upon the correlation of the roentgenologic and clinical manifestations of the various types of joint disease, and upon the roentgenologic signs by which these types are distinguished from each other, and by which progression from early to late stages is followed.

COURSE 416

Room 732 **Period: F-1**

HAROLD O. PETERSON, M.D.,
St. Paul, Minn.

Roentgen Examination of the Urinary Tract

The material for this course has been taken from an active urologic service at the Miller Hospital in St. Paul. The material will be supplemented by cases from the University of Minnesota Hospitals. The greater part of the course will deal with intravenous or excretion urography. The routine procedures will be thoroughly discussed, including the preparation

of the patient, use of cathartics, pitressin, dehydration, type of contrast media used, compression, time interval for films, position of patient, etc. In addition to the normal variations, an attempt will be made to cover most of the lesions of the urinary tract and some of the congenital anomalies which can be recognized by intravenous urography. Emphasis will be placed on practical procedures and on the urologic diseases more commonly encountered, rather than on theoretical considerations. Original roentgenograms will be used for illustration with the use of a special projector.

COURSE 417

Room 738 **Period: T-1**

L. R. SANTE, M.D., St. Louis, Mo.

The Minute Anatomy and Physiology of the Lung; Its Behavior in Health and Disease

The anatomical relationship, and the correlation of function, of the minute structures of the lung is an arrangement which is probably more intricate than any found elsewhere in the body. The balance of physical forces brought to bear upon the lung structures in the physiology of normal respiration, and the safeguards against interference with this function during disease, are remarkable.

A study of the pathogenesis of diseases of the lungs and correlation of the microscopic and roentgenological findings in these conditions should lead to a clearer understanding of both methods of examination.

Such correlated studies will be presented in a number of pulmonary diseases: atelectasis, emphysema, pulmonary congestion, pulmonary edema, drug reactions, pneumonia, etc.

As a result of the behavior of the lung structures under such disease conditions certain disputed points in the minute anatomy and function of the lung may be clarified.

COURSE 418

Room 706 **Period: W-1**

RICHARD SCHATZKI, M.D., Cambridge, Mass.

Roentgen Examination in Certain Abnormalities of the Esophagus

Technique
Normal esophagus
Curling
Scleroderma
Varices
Cancer
Extramucosal lesions

COURSE 419

Room 744 **Period: W-2**

WENDELL G. SCOTT, M.D., St. Louis, Mo.

Low Back Pain: An Evaluation of Present-Day Concepts

Various concepts and conditions have been described by orthopedists as a cause of low back pain. In the past years these have been popularized and have enjoyed a vogue almost as volatile as fashions. They are briefly reviewed in the light of present-day knowledge.

Lantern slides will be used to illustrate various conditions which cause low back pain and which can be demonstrated by roentgenographic means. The discussion will include references to the different roentgenographic techniques used in the examination of patients with low back pain.

COURSE 420

Room 732 **Period: T-1**

PAUL C. SWENSON, M.D., Philadelphia, Pa.

Diagnostic Procedures in the Study of the Large Intestine

This course will deal with all methods now used in roentgenography. An attempt will be made to include all practical procedures used in most hospitals and clinics, with a discussion of the conditions known to be amenable to roentgen diagnosis.

COURSE 421

Room 736 **Period: F-2**

BARTON R. YOUNG, M.D., Philadelphia, Pa.

Roentgen Diagnosis of Diseases of the Air and Food Passages of the Neck; Planigraphy of the Larynx

The normal roentgen anatomy of the soft tissues of the air and food passages is reviewed in detail in the first part of the course. Roentgenoscopy is an indispensable preliminary procedure, so considerable time is devoted to a discussion of this part of the examination. The disturbances in deglutition due to tumor, infection or faulty innervation and the altered physiology and morphology of the larynx that result from any one of these conditions are readily detected by roentgenoscopic examination, and the roentgenoscopic appearances of some of the more common lesions are shown.

The changes in the air and food passages produced by foreign bodies and inflammatory and neoplastic

diseases are demonstrated by exhibiting non-planigraphic and planigraphic roentgenograms. A technique for obtaining posteroanterior studies using non-planigraphic methods is outlined, and the value of this procedure for lateralizing laryngeal lesions is emphasized by showing illustrative cases.

The indications for body section roentgenography, and the results obtained from the application to the neck are presented. Planigraphy is of maximum value in the demonstration of tumors of the larynx but its superiority to conventional roentgen methods is not limited to the larynx. The planigraphic appearance of a number of interesting lesions in the larynx and cervical trachea is shown and discussed

CONDENSED SCHEDULE OF COURSES ON TUESDAY, SEPT. 14

Code: T-1 — **Single Period—8:30 to 9:30 A.M.** — **Code: T-1**

417—Sante	The Minute Anatomy and Physiology of the Lung	**101—Williams**	The Nature and Production of Radiosotopes
S-1—Hewitt	Suggestions Concerning the Writing and Presentation of Medical Papers	**306—Lenz**	Radiotherapy of Ocular Lesions
420—Swenson	Diagnostic Procedures in the Study of the Large Intestine	**305—Leddy**	Roentgen Therapy for Carcinoma of the Breast
402—Childe	The Normal Encephalogram and Ventriculogram	**409—Holt**	The Mechanisms of Skeletal Growth
405—Doub	Myelography	**201—Braestrup**	Common Causes of Radiation Hazards in Radiology

CONDENSED SCHEDULE OF COURSES ON WEDNESDAY, SEPT. 15

Code: W-1 — **1st Period—8:30 to 9:20 A.M.** — **Code: W-1**

B—Golden	Roentgenology of the Small Intestine	**102—Quimby**	Dosage Problems in the Use of Radioactive Isotopes
D—Rigler	Roentgen Manifestations of Bronchogenic Tumors	**418—Schatzki**	Roentgen Examination in Certain Abnormalities of the Esophagus
406—Good	The Small Intestine	**E—Snow**	Roentgen Study of Pregnancy
403—Childe	The Pneumographic Diagnosis of Expanding, Contracting and Atrophic Intracranial Lesions	**S-2—Fuchs**	Influence of Exposure Factors on Roentgenographic Quality
411—Macmillan	Roentgen Examination of the Sinuses	**204—Taylor**	High Voltage Generators

Code: W-2 — **2nd Period—9:30 to 10:30 A.M.** — **Code: W-2**

414—Neuhauser	The Roentgen Diagnosis of Congenital Cardiovascular Abnormalities Amenable to Surgery	**310—Jacox**	Complications following Irradiation of the Pelvis
D—Rigler	Roentgen Manifestations of Bronchogenic Tumors	**308—Martin**	Complete Care of Cancer of Mouth and Lip Including Cervical Metastases with Irradiation Alone
415—Paul	The Roentgenology of the Rheumatic Diseases	**E—Snow**	Roentgen Study of Pregnancy
404—Donaldson	The Early Diagnosis of Gastric Cancer	**S-2—Fuchs**	Influence of Exposure Factors on Roentgenographic Quality
419—Scott	Low Back Pain: an Evaluation of Present-day Concepts	**205—Weatherwax**	Factors Affecting Roentgen-Ray Dosage

CONDENSED SCHEDULE OF COURSES ON THURSDAY, SEPT. 16

Code: Th-1 — **Single Period—8:30 to 9:30 A.M.** — **Code: Th-1**

B—Golden	Roentgenology of the Small Intestine	**103—Hamilton**	The Clinical Applications of Radioactive Iodine
F—Wyatt Randall	Benign and Malignant Lesions of Bone	**C—Peirce**	Bronchography
311—Widmann	Radiation Therapy in Cancer of the Skin	**301—Eberhard**	Treatment of Leukemias and Lymphomas
A—Bromer	The Differential Diagnosis of Skeletal Changes Occurring in Diseases of Infants and Children	**401—Austin**	Interpretation of the Dental Roentgenogram
412—Macmillan	Roentgen Examination of the Mastoids	**203—Taft**	Dosage Measurement from a Clinical Standpoint

CONDENSED SCHEDULE OF COURSES ON FRIDAY, SEPT. 17

Code: F-1 — **1st Period—8:30 to 9:20 A.M.** — **Code: F-1**

E—Golden	Roentgenology of the Small Intestine	**104—Corrigan**	The Practical Use of Tracer Isotopes
F—Wyatt Randall	Benign and Malignant Lesions of Bone	**C—Peirce**	Bronchography
416—Peterson	Roentgen Examination of the Urinary Tract	**304—Lampe**	Radiation Therapy of Selected Miscellaneous Nonmalignant Conditions
A—Bromer	The Differential Diagnosis of Skeletal Changes Occurring in Diseases of Infants and Children	**S-2—Fuchs**	Influence of Exposure Factors on Roentgenographic Quality
412—Macmillan	Film Reading Session	**303—Fricke**	Radium Therapy for the Less Common Malignant and Non-Malignant Conditions

Code: F-2 — **2nd Period—9:30 to 10:30 A.M.** — **Code: F-2**

410—Kirklin	Newer Developments in Cholecystography	**105—Reinhard**	The Treatment of Blood Dyscransias and Malignant Lymphomas with Radioactive Phosphorus, Radioactive Sodium, and Colloidal Preparations of Various Radioactive Isotopes
408—Hodges	Intracranial Angiography	**302—Ernst**	Practical Concepts of Radiation Treatment of Carcinoma of the Cervix Uteri
407—Hare	Recent Studies on Certain Intracranial Measurements	**309—Portmann**	Contact Roentgen Therapy for Superficial Lesions
421—Young	Roentgen Diagnosis of Diseases of the Air and Food Passages of the Neck; Planigraphy of the Larynx	**S-2—Fuchs**	Influence of Exposure Factors on Roentgenographic Quality
307—Leucutia	Comparison of 200 kv. and Supervoltage Roentgen Therapy	**206—Weatherwax**	Factors Affecting Radium Dosage

DEPARTMENT OF TECHNIQUE

Department Editor: Robert B. Taft, M.D., B.S., M.A., 103 Rutledge Ave.
Charleston, S. C.

ON THE UTILIZATION OF THE OPTIMUM PRIME FACTORS IN SPOT ROENTGENOGRAPHY

WITH SPECIAL REFERENCE TO GASTROINTESTINAL ROENTGENOGRAPHY

By A. M. McNABB, M.D.
Medical Arts Building

AND

ISAAC L. NEWTON
National Research Laboratories
OTTAWA, CANADA

THE three prime factors in producing roentgenograms of the highest quality are:

(1) Sharpness of detail controlled by
  (a) Focal spot size
  (b) Focal film distance
  (c) Speed of exposure
  (d) Object film distance
(2) Degree of contrast controlled by
  (a) Kilovoltage used
  (b) Elimination of secondary radiation
(3) Uniformity of density controlled by
  (a) Total radiant energy reaching the film
  (b) Time-temperature processing of the film

Roentgenography of the gastrointestinal tract as routinely done leaves much to be desired. Present equipment generally comprises a stationary anode tube with a fixed focal spot of some 3.6 or more millimeters in diameter, possibly a fixed filter grid, and in most cases an absolute timer of a synchronous motor driven type. As a current of 100 milliamperes is about the maximum consistent with tube life, the focal film distance is relatively short. Each of these items adversely affects the quality of the roentgenogram. Inasmuch as the focal spot is comparatively coarse and the focal film distance short, fine detail is lost. Moreover at the milliamperage available a compromise must be struck between detail and contrast. To improve contrast a reduction in kilovoltage would lengthen the exposure time, as would also the use of a stationary filter grid. Over and above this increased exposure time with the added likelihood of movement, there is the objectionable evidence of grid lines. Uniformity of density can only be obtained by frequent adjustment of an absolute timer from patient to patient, and from position to position. Resulting errors in judgment frequently require departure from routine time-temperature development in order to maintain uniform density.

Three basic improvements must therefore be made if results of improved quality are to be obtained:

(1) The tube must be capable of passing a much higher milliamperage and must have a smaller focal spot.

(2) A moving grid must be substituted for the fixed grid on the roentgenoscopic screen assembly.

(3) The timer must automatically control the total radiant energy reaching the film and be independent of the body build and position of the patient.

This paper outlines in a general way our experience in adding these improvements

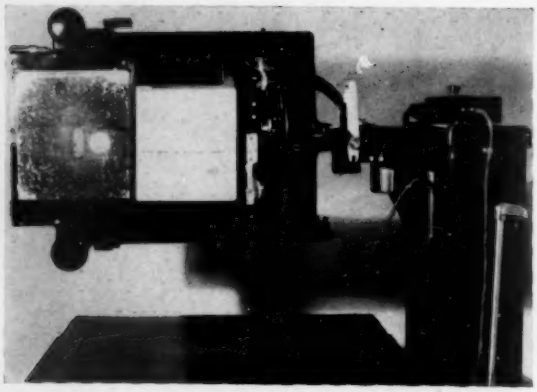

FIG. 1. Screen carriage assembly showing cassette in place, roentgenoscopic screen, photoelectric tube above screen; photoelectric sensitivity control is on top of standard—right.

to a stock motor driven tilt table. The tube selected was a compactly designed rotating anode type with a focal spot of 2 mm. The energy used for roentgenography is 250 ma. and that used for roentgenoscopy with the anode at rest is usually 3 ma. The latter has been found quite sufficient when used at 80 to 90 kilovolts (peak). As the tube is the shockproof cable type, requiring no consideration for high voltage clearance, it was found possible to increase the anode film distance without affecting the travel of the carriage in any way. The anode is now 26 inches behind the table top compared with an original 22 inches, and a maximum focal film distance of 36 inches is possible with the screen at full extension. The installation of a fan inside the table increases the heat dissipation and permits almost continuous operation for all practical purposes.

The decrease in the size of the focal spot and the longer focal film distance, combined with the shorter exposure time made possible by the increased power, made a noteworthy improvement in detail. The increased power in association with a reduction in kilovoltage during roentgenography likewise improved contrast, but not to the degree desired in obese subjects, or in extreme oblique projections. A stationary grid gave satisfactory contrast but the grid lines were considered objectionable under certain circumstances, especially in views of the cap where fine rugae detail was wanted.

A moving grid was designed which has a light mechanism operating in all positions of the tilt table, and no manual presetting is needed as to position or time between exposures. The apparatus consists of a thin focussed wafer grid mounted on linear springs. During roentgenoscopy the grid is stationary with the springs under maximum tension. For roentgenography the movement of the cassette across the tray trips the spring retaining catch. The grid then oscillates with a decaying amplitude of a damped wave type. Withdrawal of the cassette again resets the springs on tension. By such an arrangement it is theoretically impossible to superimpose one line image on top of another, and the period of vibration is such that all desired exposure times are taken care of. In practice, the grid lines are suppressed entirely on most roentgenograms and at no time are they prominent.

The tray on which the grid is mounted replaces the standard roentgenoscopic screen, and being of approximately the same size and weight, no major alterations were required. The left of the tray serves as a receptacle for the unexposed film and is protected by lead. On the right there is an 8 by 10 inch roentgenoscopic screen and the grid is housed on the patient's side of the screen with a tunnel the depth of the cassette between. In the space between the tunnel and the grid, a sliding mask is incorporated. This arrangement permits a choice of a single 8 by 10 inch exposure, or of two 4 by 10 inch or four 4 by 5 inch exposures on an 8 by 10 inch film. A cone for pressure is also placed on the patient's side of the device, and both cone and mask may be readily moved into place by convenient controls. To obtain a roentgenographic exposure, the cassette is moved across under the screen, and as it travels a small lever is elevated by the top of the cassette. This lever promptly trips the grid, closes a micro switch, and through a series of relays energizes the timer, boosts the valve and tube filament current, starts

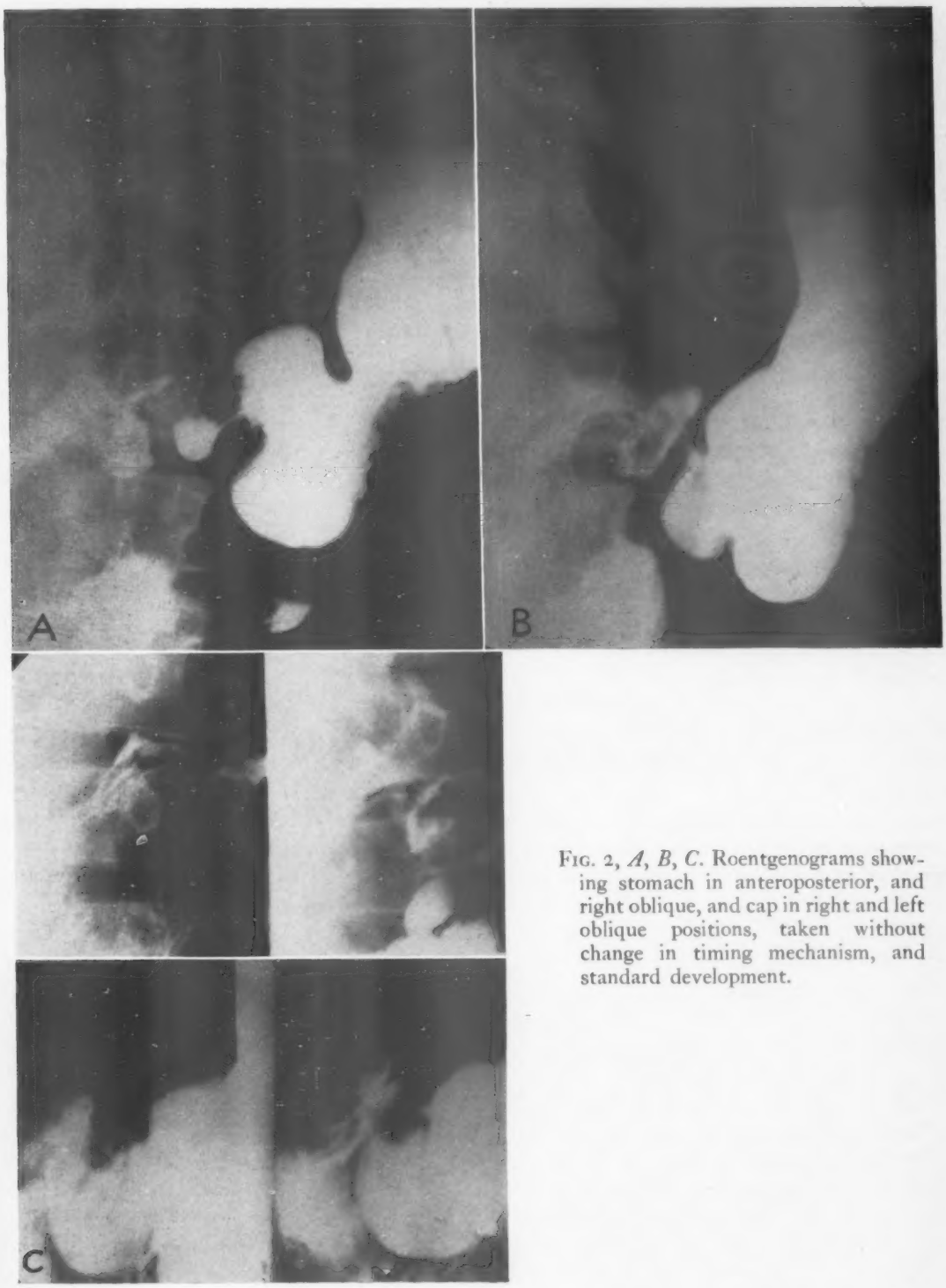

Fig. 2, *A*, *B*, *C*. Roentgenograms showing stomach in anteroposterior, and right oblique, and cap in right and left oblique positions, taken without change in timing mechanism, and standard development.

the rotor, and in the course of less than a second an exposure of 250 ma. is initiated for the proper period of time.

Benefiting from the work of Morgan in his development of a photoelectric cell type of timer, it was found possible to adopt the device and thus control the amount of radiant energy reaching the film, largely

irrespective of the body build or position of the patient. The photoelectric cell was mounted at the top left of the roentgenoscopic screen, and in this position the exposure is quite accurately controlled by the fluorescent image on the screen during roentgenography.

As already noted by Morgan, the sensitivity of the photoelectric timer does not entirely parallel film sensitivity under all conditions, particularly with extremes in body thickness, or with marked change in kilovoltage. We have also found that different structures show up better at different film densities. The gallbladder, for example, seems clearer on lighter films and using a lower kilovoltage than we would employ for the stomach. For these reasons, and for others inherent in the timer design, part of the mechanism was placed on the right of the roentgenoscopic carriage. A small control knob convenient to the hand of the operator, with a pointer easily felt in the darkened room, enables tube sensitivity to be changed and any required film density readily obtained.

The apparatus as described has been chiefly used in gastrointestinal work. To a lesser extent it has been used to obtain a permanent record of any roentgenoscopic examination, including such parts as the gallbladder in the standing position, the lungs, spine, foreign body localization, and fractures. The roentgenograms possess satisfactory detail, good contrast, and compare favorably with those of similar regions made with a standard diaphragm at a comparable focal film distance. The largely automatic timing, associated with the added convenient manual adjustment described, enables such roentgenograms to be readily obtained of a wide variety of parts, as well as maintaining routine time-temperature dark room processing.

SUMMARY

The prime factors affecting the quality of roentgenograms have been discussed in relation to apparatus currently available for utilizing roentgenoscopic film technique.

An apparatus has been described which improves the quality of roentgenograms and extends the field of this technique, utilizing:

(1) A rotating anode tube.
(2) A light weight moving grid of original design.
(3) A photoelectric timer of the basic Morgan design.

Medical Arts Building
Ottawa, Canada

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ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

HEAD

Ingraham, Franc D., and Cobb, Cully A., Jr. Cerebral angiography; a technique using dilute diodrast. *J. Neurosurg.*, Sept., 1947, *4*, 422–434.

Diodrast is a suitable medium for cerebral angiography. It is inert in the body, quickly excreted, and highly soluble. When large quantities of a concentrated solution are used in angiography, reactions attributable to the hypertonicity of the solution may be encountered. To obviate the occurrence of reactions a method of injecting small quantities of dilute solutions of diodrast with a special angiogram needle is presented. The needle is a No. 18 having a curve of about 60 degrees with its bevel on the outer side of the curve. A rounded shoulder 4 mm. above the opening is placed eccentrically so that its plane of contact with the artery when the needle is in place is at an angle of 45 degrees. This allows the shoulder to form a tight seal and to prevent the needle from advancing into the artery. The needle is connected to the syringe through an ordinary three-way stopcock.

The common carotid artery is exposed through a short transverse incision 2 to 3 cm. above the clavicle. A single loop of moist cotton tape is placed around the artery and attached to a hemostat. While gentle traction is made, the angiogram needle is inserted about 2 mm. above the tape with the stopcock in the off position. After one of the 10 cc. Yale B-D Lok syringes containing 35 per cent diodrast has been attached to the side arm of the stopcock the anode of the roentgen tube is started in rotation. The stopcock is turned to connect the syringe and needle and a stream of blood entering the syringe demonstrates the patency of the system. The injection of 10 cc. is made in approximately two seconds, and as the 2 cc. mark is crossed the roentgen technician is asked to expose the film. The actual exposure coincides with the completion of the injection. After the roentgenogram is made the valve is turned off and the syringe is disconnected. This procedure is repeated for the stereoscopic duplicate and for an anteroposterior arteriogram. The needle is left in place until the films are developed. It is then withdrawn and pressure is made against the arterial puncture until bleeding stops. The wound is irrigated with saline and closed with interrupted silk sutures.

Diodrast appears to be a safe contrast medium for cerebral angiography in both adults and children when used in this way. Roentgenograms of satisfactory quality are secured and several injections may be made for stereoscopic and anteroposterior projections, and for demonstration of two or more of the four arterial networks of the brain.—*K. K. Latteier.*

Peyton, William T., and Simmons, Donald R. Neurofibromatosis with defect in wall of orbit. *Arch. Neurol. & Psychiat.*, March, 1946, *55*, 248–265.

The concept of this disease has changed radically since von Recklinghausen's description in 1882. The cutaneous tumors and pigmentation are only two manifestations of a congenital defect which may involve any or all of the systems of the body.

The hereditary nature has been conclusively established; the controlling factor is a dominant one which follows regular mendelian principles. Evidence is stated to suggest that the cause of the disease lies in defective germ plasm.

A difference of opinion exists as to the cellular origin of the neurofibroma. Masson attributes it to the sheath of Schwann cells and proposes the term "schwannoma." Penfield and Young believe that the tumor is produced from fibroblasts and preserves the characteristics of connective tissue.

The osseous lesions have been classified under three headings:

1. Scoliosis.
2. Abnormalities of growth of individual bones.
3. Irregularity of outline of bones, ranging from central or subperiosteal cysts to pedunculated subperiosteal tumors.

The bones of the skull are commonly involved. Lesions which have been described are:

bulging of circumscribed areas, peculiar vascular designs, enlargement of the sella, enlargement of the orbit and of the optic canal, various types of gross asymmetry, subperiosteal cysts and "bone atrophy and erosion." Bony defects can be due to destruction of bone by neurofibroma or they can be associated congenital defects. The latter are demonstrated in neurofibromatosis with defect in the orbital wall, inasmuch as there is no orbital tumor present in some instances.

Defects in the wall of the orbit, permitting free communication between the intracranial cavity and the orbit, are not often mentioned in the literature. In a review of the literature, the authors found 20 cases with defects in the wall of the orbit. The present paper reports 5 cases collected over a ten year period and it is suggested that the syndrome is not as rare as the paucity of reports might infer.

Temporal or parietal bossing has been reported as one of the common changes in the skull associated with neurofibromatosis. This condition was noted in 4 of the 5 cases observed by the authors, the roentgenograms showing bulging in the temporal region on the side of the tumor. Roentgen evidence of increased pressure is seen frequently in children. Other types of tumors, both of the brain and of the body in general, are frequently found in association with neurofibromatosis. Thirteen per cent of the neurofibromas undergo malignant change but tumors having no relationship to the neurofibroma are commonly seen. Gliomas and meningiomas are frequently associated with neurofibroma.

Exophthalmos was seen in all of the cases presented in this paper. Two factors may produce this change: (1) the presence of a retrobulbar neurofibroma or an associated tumor such as a glioma of the optic nerve; (2) encroachment on the orbital structures by the intracranial contents which proved to be the chief cause in this series of cases.—*Robert N. Byrne.*

Soule, Arthur B., Jr., and Whitcomb, Benjamin B. Extensive erosion of the base of the skull from a leptomeningeal cyst. *Arch. Neurol. & Psychiat.*, April, 1946, *55*, 382–387.

Erosion of the cranial bones from pressure of a leptomeningeal cyst is an uncommon, but not rare, condition. While the majority of such cysts develop after severe trauma to the skull, usually with fracture, there is evidence that congenital abnormalities in the dura and leptomeninges may contribute to their production. These cysts are noted more commonly in the parietal, frontal, and occipital regions.

The reported case is of a twenty-eight year old soldier who was admitted to an Army General Hospital with swelling about the right orbit and temporozygomatic region and with exopthalmos on the same side. Complaints concerning the affected region dated back one and a half years at which time the patient suffered a mild cerebral concussion as a result of an explosion. One year later, roentgenograms demonstrated cystic changes in the right anterior temporal region and in the walls of the orbit. A tentative diagnosis of cystic bone tumor or a vascular neoplasm was made. He was evacuated to the United States. A repeat examination revealed extensive destruction of bone in the middle cranial fossa with complete erosion of both tables of the skull and herniation of the cyst into the pericranial tissues.

The differential diagnosis discussed included the following possibilities: meningioma; epidermoid tumor or cholesteatoma; osteogenic sarcoma; xanthomatosis; leptomeningeal cyst; myeloma; metastatic malignant disease; localized osteitis fibrosa cystica.

Successful operative interference was carried out and the operative findings are described. The concluding comment includes several opinions as to the mechanics of origin of these cysts.—*Robert N. Byrne.*

NECK AND CHEST

Bradsford, Martin L., Mahon, Hugh W., and Grow, John B. Mediastinal cysts and tumors. *Surg., Gynec. & Obst.*, Oct., 1947, *85*, 467–494.

The authors emphasize, as does John Alexander, "The majority of circumscribed intrathoracic neoplasms arise within the lung (almost all of them being malignant); many of those that arise outside of the lung are malignant; and, therefore, the prompt removal of any circumscribed neoplasm which cannot be proved benign is of vital importance."

Congenital Cysts

Epidermoid cysts, dermoid cysts and teratomas. Epidermoid is the simplest of the cysts lined by stratified squamous epithelium supported by fibrous tissue and its contents are desquamated

and degenerated epithelial cells. Dermoid cysts are lined by stratified squamous epithelium with added elements in their walls of structures ordinarily arising from skin; sebaceous glands, coil glands, hair and teeth. The teratomas include elements of all three layers so that all structures of the epidermoid or dermoid may be present plus ciliated and cylindrical cell structures of gut or respiratory tract origin; muscle, bone, cartilage, lymphoid tissue, brain and thyroid.

Pericardial celomic cysts. This type of cyst is thin-walled and contains clear fluid. The so-called "spring water" cyst may be included under this heading.

Bronchial cysts of the mediastinum. These congenital cysts of the mediastinum are characterized by ciliated columnar epithelium in their lining membranes. Cartilage and smooth muscle bundles are often present in their walls.

Esophageal cysts and gastroenteric cysts. Those cysts included within the muscularis of the esophagus can be called esophageal cysts; those located in the rest of the mediastinum or lung can be of bronchial origin. Gastroenteric cysts are rare. They are characterized by the resemblance to gastric and intestinal structures.

Cystic lymphangiomas. These cysts are also called "cystic hygromas." They are very rare in the mediastinum and are characterized by multiloculated cysts containing fluid with an endothelial lining and smooth muscle and lymphocytes in the walls.

Connective Tissue Tumors

Fibromas. This is a rare lesion. It is usually "silent" for years.

Lipomas. Most of the intrathoracic lipomas originate in the mediastinum. They may attain giant size and cause death from pressure.

Leiomyomas. Many of the intramural extramucosal tumors of the esophagus are leiomyomas. It is important to remove these growths because of the possibility of sarcomatous degeneration.

Xanthomas. It is questionable that these tumors should be considered as a separate type.

Chondromas, chondromyxomas, chondromyxosarcomas. These tumors originate from cartilage which is found adjacent to the mediastinum in the sternum, costal cartilages, and articular surfaces of the spine and costovertebral junctions. They are important in that they attain great size and may metastasize even though benign on microscopic section.

Neurogenic Tumors

These tumors arise from the sympathetic nervous chain or its anlagen.

Neurofibromas. These tumors are thought to come from the perineurial or endoneurial fibrous tissue and are distinguished from the tumors of the sheath of Schwann which are characterized by elongated fusiform cells with "pallisading" of the nuclei.

Ganglioneuromas. Scott and Palmer classified the tumors of the peripheral sympathetic system according to degree of differentiation. Ganglioneuroma lies with pheochromocytomas and astrocytomas in the completely differentiated group. There is a very low tendency toward malignancy.

Primary Tumors of the Thymus

There is considerable confusion regarding classification of the tumors of the thymus.

Benign thymomas. The present knowledge of the relationship between myasthenia gravis and tumors of the thymus is sketchy.

Malignant thymomas. The lymphosarcoma or thymoma, which probably originates from the reticulum cells, is the most common type.

Thymic cyst. This is a rare entity in adults. A few cases have been reported in infants.

Primary Tumors of Lymph Nodes

Lymphosarcomas. Primary sites of lymphosarcoma in order of frequency are: cervical, mediastinal, retroperitoneal and mesenteric nodes.

Hodgkin's disease. Jackson and Parker showed mediastinal or hilar nodes to be involved in 52 per cent of their 174 cases of Hodgkin's granuloma, with one-third of the cases of Hodgkin's sarcoma showing involvement.

Boeck's sarcoid. Boeck's sarcoid is a pitfall in the common practice of using a "test dose" of deep roentgen therapy to establish the diagnosis of "malignant lymphoma." Riesner states that over 85 per cent of 35 cases showed mediastinal node involvement, and that 6 of these cases showed practically complete disappearance of the shadows while being watched; half of the total showed some regression.

Endotheliomas. This is a rare type of primary tumor of the lymph nodes.

Primary and Secondary Sarcomas

Any of the connective tissue in the medi-

astinum may be the site of sarcomatous growth. Unfortunately, there is no way to distinguish between the benign mediastinal tumors and the malignant on roentgen examination. Total removal is possible in early cases and metastasis is usually late.

Secondary sarcomas of the mediastinum are extremely rare as hematogenous spread is more frequent, therefore involving the lungs before the mediastinum.

Primary and Secondary Carcinomas

The most frequent origin of primary carcinoma of the mediastinum is the thymus. Primary sarcomas are three to four times as frequent as primary carcinomas.

Secondary carcinomas of the mediastinum usually come from lung, esophagus or breast, and occasionally from abdominal viscera.—*Mary Frances Vastine.*

Ecker, Arthur, and Chamberlain, Richard H. An additional approach to the internal carotid artery for cerebral angiography. *J. Neurosurg.*, Sept., 1947, *4*, 444–450.

The purpose of this paper is to describe an additional site through which roentgenographic contrast medium may be introduced into the internal carotid artery. The site described is immediately below the carotid foramen at the base of the skull. Here the internal carotid artery is relatively fixed because of the proximity to its bony canal.

The point of entry of the spinal needle is chosen on the skin 3 mm. anterior to the posterior edge of the ascending ramus of the mandible at the point where the latter is most concave. The needle is directed upward and medially in relation to the skull and backward in line with the center of the external auditory canal. It must pass through a triangle of bone bounded by the styloid process below, the ascending ramus of the mandible in front, and the tympanic plate above. When the needle passes through the wall of the artery, a definite "give" may be felt, but it is frequently necessary to strike the medial wall of the carotid foramen and then withdraw the needle very slowly until arterial blood gushes forth. It is then in the proper position in the internal carotid artery. The injection should be made quickly so that 10 cc. of 35 per cent diodrast is placed within the artery in less than three seconds.

The authors first attempt percutaneous injection of the common carotid artery and if this procedure is unsuccessful, injection of the internal carotid as described is the next procedure of choice. Should this method also be unsatisfactory, direct exposure of the carotid is then employed.

The authors are also aware of disadvantage of the method described, and advise against the use of thorotrast as a contrast medium because of the danger of extravasation. However, the high injection site allows use of low concentration contrast medium with reduced total amount of medium employed, and the advantage of direct injection into the internal carotid artery.—*K. K. Latteier.*

Görgényi-Göttche, O., and Kassay, D. The importance of bronchial rupture in tuberculosis of endothoracic lymph nodes. *Am. J. Dis. Child.*, August, 1947, *74*, 166–206.

The authors agree with Rössle who believed that the shadows known previously as "epituberculosis" in the lungs were nothing but the roentgen picture of atelectasis. They trace the reports in the literature since 1919 when Kleinschmidt observed large shadows in the lungs of tuberculous children which disappeared later without trace. In 1920, Eliasberg and Neuland considered these shadows regressive and harmless and named them epituberculous infiltrations.

In this paper, 12 cases are reported in detail, all of which have reproductions of the roentgenographic findings. In addition to the usual roentgenograms of the chest, tomography was employed in the examination of the patients. This best demonstrated the trachea, the main bronchi and even the smaller bronchi. Twenty-eight cases were subjected to bronchoscopy. In 18, there was evidence of rupture of a lymph node into a bronchus; in 3, encroachment on a bronchus by a lymph node was demonstrated, and in 7, bronchoscopy was without result. They concluded that a common cause was present in the cases having shadows such as described by Eliasberg and others, namely, rupture of caseous lymph nodes into the bronchi.

In confirmation of their opinion, the authors quote the work of Kálló whose report in more detail will be published later. He found that in 17 cases of tuberculosis in children which came to autopsy, 8, or 47.1 per cent, revealed bronchial rupture. Careful technique at autopsy is required to demonstrate the rupture. Some-

times only a very small opening is found through which the contents of a caseous lymph node expands into the lumen of a bronchus. Many children die of tuberculous meningitis before the stage of bronchial rupture occurs. In 3 of the 17 cases, the primary focus ruptured into a bronchus. In 1 case, a lymph node ruptured into a main bronchus and a double rupture occurred in 2 cases. The sites where the rupture had taken place were as follows: secondary and tertiary bronchi, 6 cases (5 of them lower lobes); primary bronchus, 6 cases (2 into the middle and 2 into the lower lobes); main bronchus, 4 cases and trachea, 1 case. In only 9 cases of the 17 (53.9 per cent) could the location of the rupture have been discovered by means of the bronchoscope.

Bronchi which were examined at autopsy, frequently showed arched lymph nodes which apparently coalesced with the wall of the bronchus, and while destroying it, they encroached on the lumen. The encroaching lymph nodes then can be considered the prelude of rupture. Sometimes spontaneous evacuation of the caseous masses within the bronchi can occur.

The clinical signs and symptoms are described in detail. In some, they are striking and alarming, while in others, which are in the majority, they are not pronounced. These, the authors term silent cases.

Among the roentgen signs, those of atelectasis are important, especially the so-called Holzknecht-Jakobson, sign, namely, the movement of the mediastinum during deep inspiration toward the side of the bronchial stenosis. Obstructive emphysema is an imperative indication for bronchoscopy.—*R. S. Bromer.*

FAGIN, I. DONALD, and SCHWAB, EDWARD H. Spontaneous mediastinal emphysema. *Ann. Int. Med.*, June, 1946, *24*, 1052–1072.

Three patients with spontaneous mediastinal emphysema are reported. The pathogenesis and clinical features of the condition are discussed in detail.

The present conception of spontaneous mediastinal emphysema is that air leaks from alveoli into perivascular connective tissue and thence into the hila and mediastinum. This postulates a defect in alveolar walls due to emphysema or disease which allows air to reach the sheaths of pulmonary blood vessels. The pumping action of respiration, due to lengthening and shortening of the pulmonary vessels, forces air along these perivascular sheaths to the mediastinum. Under certain conditions, the distended sheaths of the pulmonic blood vessels may cause interference with blood flow and circulatory embarrassment.

Males were affected 12 times as often as females. The average age was twenty-six years. There was no occupational predisposition. In less than one-half of the patients, physical exertion seemed related to the mediastinal emphysema.

Sudden pain was usually the first symptom. The pain often suggested a cardiac accident in onset and distribution. It lasted from a few hours to days.

A peculiar crackling or crunching sensation was often a subjective finding. Dyspnea varied depending upon the degree of associated pulmonary collapse.

Mediastinal crepitation was the characteristic clinical finding. It was audible for periods ranging from hours to six weeks. Sometimes, it varied from day to day being audible once, and not heard later.

Pneumothorax, particularly left sided, was a common occurrence. It occurred more frequently in patients most severely affected.

The roentgenographic evidence of air in the mediastinum clinched the diagnosis. Unfortunately, less than half of the cases revealed air along the cardiac borders or in the anterior mediastinum.

The prognosis was uniformly good in adults. Infants offered a more serious prognosis.

This is a well documented review with an excellent bibliography.—*Philip J. Hodes.*

FENICHEL, NATHAN M., and EPSTEIN, BERNARD S. The clinical and roentgenologic diagnosis of pericardial effusion. *Ann. Int. Med.*, March, 1946, *24*, 401–412.

This is a clinical review of findings in 13 patients with large pericardial collections. All had distended neck veins, hepatic enlargement, and other evidences of cardiac tamponade. All were dyspneic but only 7 were orthopneic.

The authors review the clinical manifestations of pericardial effusion. It was noteworthy that the electrocardiogram was not very helpful.

Diffuse cardiac enlargement was noted roentgenographically in all patients but the "water-bottle" appearance was seen only in six. The most reliable roentgen procedure was repeated observations for evidence of recession or progression in the size of the lesion. Fluoroscopy for differences in amplitude of pulsation

over the heart margins and great vessels was not considered diagnostic.—*Philip J. Hodes.*

ABDOMEN

Lopez-Kruger, Rodolfo, and Dockerty, Malcolm B. Tumors of the islets of Langerhans. *Surg., Gynec. & Obst.*, Oct., 1947, *85*, 495–511.

The authors summarize their article as follows:

1. Asymptomatic islet cell adenomas are more frequent than hitherto believed. Routine examination of 10,314 pancreases revealed 44 such tumors and a carefully conducted study of 500 pancreases disclosed 8 tumors (1.6 per cent).

2. Clinical hypoglycemia originating in neoplastic proliferation of islet cells is a rare disease. Such proliferation can be manifest in 4 ways pathologically: (1) benign adenomas, 70 per cent; (2) islet cell adenomatosis, 2 per cent; (3) histologically malignant but non-metastasizing islet cell tumors, 20 per cent; (4) metastasizing islet cell carcinomas, 8 per cent.

3. Generally productive of a clinical history measured in half decades, the adenomas are small, fairly well encapsulated nodules with high degrees of cellular differentiation and no mitosis. The histologically malignant or "border-line" tumors are, on the average, twice the size of the adenomas and are more vascular and more invasive. The presence of cellular atypia, hyperchromatism, and mitosis is that of grade 1 (Broders) order of malignancy and is paralleled in a general way with a relatively short clinical history. The possibility of metastasis should be considered in members of this group in which vascular invasion is present. Measured in clinical terms of months rather than years and sometimes of production of a paradoxical gain in weight, metastasizing islet cell carcinomas demonstrate a large size, gross invasive tendencies and metastasis with microscopic evidence of manifestly malignant cells and vascular invasion. In all of the groups positive results using special staining methods will be obtained in some but not all of the tumors. The results do not justify the conclusion that functioning pancreatic insular tumors are beta cell neoplasms.

4. Statistically speaking, the surgeon can expect to find a tumor in from 50 to 60 per cent of the cases on the first exploration. The presence of multiple tumors (10 to 15 per cent in the border-line and the metastasizing malignant groups) will sometimes decide the necessity of repeated operations in search for the causative tumor (persistence of hypoglycemia after partial pancreatectomy for hyperfunctioning tumor). "Blind" resection of the tail of the pancreas will remove 50 per cent of the tumors; resection of the body as well as the tail will account for about 20 per cent more. Total pancreatectomy will occasionally be necessary for some of the small buried tumors located in the head of the gland, which is the site of about 20 to 30 per cent of the neoplasms. Very rarely (1 to 2 per cent) the tumor will have an extrapancreatic location.

5. The surgeon performing an operation for the relief of hypoglycemia must be prepared to carry out procedures ranging all the way from simple excision of an easily identified and readily shelled out tumor to total pancreatectomy. These procedures are justified by the complete failure of medical treatment of organic hypoglycemia.—*Mary Francis Vastine.*

Jackman, Raymond J., Neibling, Harold A., and Waugh, John M. Carcinoma of the large intestine *J.A.M.A.*, Aug. 16, 1947, *134*, 1287–1289.

A study of the records of all patients with carcinoma of the colon and rectum who came to the Mayo Clinic during the year 1944 was made. There were 817 patients in the group with a total of 825 lesions. The purpose of the study was to determine the nature of the treatment in relation to the location of the carcinoma. More specifically, the study consisted in considerations on (1) how many carcinomas of the large intestine within reach of the examining finger are diagnosed and treated as some other disease during the course of the patient's symptoms, the carcinoma remaining undiscovered; (2) how many additional carcinomas which should have been visible at sigmoidoscopic examination are erroneously treated, and the nature of the treatment; (3) how many carcinomas discernible in roentgenograms of the colon likewise are erroneously treated, and the nature of the treatment, and (4) how many carcinomas of the large intestine are discovered only at surgical abdominal exploration.

In the group studied, more than half (54.3 per cent) of all patients with carcinoma in any part of the large intestine had lesions which could be palpated by digital examinations of the rectum. About one-fourth (23 per cent) of the patients in this group had received some form of treatment for disease of the colon or

rectum, but not for carcinoma, during the course of their symptoms arising from the unsuspected carcinoma that was within reach of the examining finger. An additional 16.2 per cent of all the patients who had carcinomas anywhere in the large intestine had lesions which were within reach of the sigmoidoscope. One-fourth (25.8 per cent) of this group had rereceived treatment for some disease other than carcinoma, which had remained undiscovered. Patients who had carcinomas of the large intestine that were beyond the reach of the examining finger and sigmoidoscope constituted the remaining 29.5 per cent of the total series of 817. Of this group 28.4 per cent had carcinomas that were diagnosed by roentgenologic studies of the colon, and 1.1 per cent had lesions that were discovered at abdominal surgical exploration. In this group, during the period of symptoms from carcinoma, only 9.9 per cent of the patients had received treatment directed toward any other condition.—*Samuel G. Henderson.*

Crohn, Burrill B., Garlock, John H., and Yarnis, Harry. Right-sided (regional) colitis. *J.A.M.A.*, May 24, 1947, *134*, 334–338.

Eight per cent of all cases of ulcerative colitis of the nonspecific type are regional or right sided in anatomic distribution. In this subgroup the pathologic process begins and is commonly limited to a segment or segments of the proximal colon; its life history is characterized by a progressive march to the left, until by skip lesion or by continuity the whole colon from cecum to sigmoid may become interruptedly or continuously involved. Clinically right-sided or regional or segmental colitis is less severe in its local signs and symptoms than is universal or left-sided colitis with its predominantly rectal involvement; that is the diarrhea, the urgency, the staining and the bloody stools are less pronounced. On the other hand, the constitutional manifestations are more apparent and are characterized by fever, often continuous, by manifestations referable to the joints, ocular complications and occasional implication of the valves of the heart.

This study comprises 77 cases of right-sided or segmental colitis under observation between the years 1928 and the present date. The causation of this form of colitis is as little specific or known as that of colitis in general or of ileitis. The average age at the time of study has been 27.3 years. The pathologic process involves one or many of the segments of the colon in its progressive course except the rectum.

The clinical manifestations of segmental colitis are both local in the intestinal tract and general throughout the body. Locally the disease is characterized by diarrhea which is rather moderate in severity. Fever, ranging from 101 to 105°F., is irregular, lower in the morning and higher at night and not continuous and sustained but irregular and peaked. The leukocyte count is usually low or only slightly elevated (8,000 or 12,000 to 15,000). Single, but more often multiple joint involvement is common. Any of many of the larger joints may be affected; the smaller joints, particularly of the hand, are frequently the site of periarticular inflammation. One of the less frequent but characteristic complications is involvement of the eye as part of a focal infection. Phlyctenular conjunctivitis, iritis, keratitis, and uveitis constitute the commoner forms. In one case there was noted an acute endocarditis, with fever and a blowing systolic apical murmur developing under observation. In this series erythema nodosum occurred twice, the rash being identical with that on the extremities so commonly observed in the severe types of universal colitis.

The roentgenograms taken after after a barium enema demonstrate disturbed mucosal pattern, irregular and moth-eaten borders of the outline of the colon, foreshortening of the lumen and absence of haustral markings in the affected segments of the large bowel. When diarrhea is minimal and when fever, articular manifestation and ocular complications (iritis, uveitis) are the obvious clinical symptoms, it is easy to understand why so frequently these cases are mistaken for chronic rheumatic fever, for Libman-Sacks disease, brucellosis or periarteritis nodosa. The leukocyte count is generally low in all of these clinical conditions; the fever is similarly frequently continuous or irregular in type.

Where the patients choose and insist on conservative therapy, retention enemas of neutral acriflavine at bedtime, chemotherapy and intramuscular injections of liver extract and vitamin B complex are used. The treatment of choice is surgical. Ileosigmoidostomy with subsequent subtotal colectomy was performed in the majority of 58 patients selected for operation. There was a 20 per cent mortality. Forty-three of these remained well, while 3 have developed subsequent disease in the rectrum.—*S. G. Henderson.*

GYNECOLOGY AND OBSTETRICS

AYRE, J. ERNEST. Cervical cancer; a disordered growth response to inflammation in the presence of estrogen excess and nutritional deficiency. Cytological, clincal, nutritional and pathologic studies. *Am. J. Obst. & Gynec.*, Sept., 1947, *54*, 363–390.

Evidence that a type of human cancer is associated with a metabolic disturbance characterized by a nutritional deficiency, an estrogen excess, and an inflammatory reaction is presented in this article. The inference is that uterine cervical cancer may be the abnormal type of inflammatory response to chronic infection which occurs in the presence of a nutritional deficiency of thiamine and an associated excess of the specific growth-hormone estrogen.

The author summarizes his findings as follows:

1. Cytology studies have been found valuable in early diagnosis of cervical cancer, and in estimating endogenous estrogen.

2. Comparative vaginal and cervical cornification counts have revealed greater concentration of estrogens in the cervix in 87 per cent of cases studied.

3. Some degree of chronic cervicitis is believed to be present in four of five adult cervices.

4. Estrogen-fixation and concentration in infected cervical tissues is believed to be a growth-stimulating factor predisposing to cancer.

5. Evidence of excessive tissue estrogen has been found in 92 per cent of 50 cervical cancers.

6. Deficient urinary thiamine excretion has been found in 86 per cent of 50 cervical cancers. Ten per cent of 50 controls showed the same deficiency.

7. Riboflavin deficiency was found in 38.8 per cent of cancer cases, and in 6.8 per cent of the controls.

8. Studies of cervical biopsies illustrating abnormal growth proliferation in the presence of cervicitis, excess tissue estrogens, and low thiamine excretion are presented.

9. Partly by speculation, partly by interpretation of evidence presented, an attempt is made to correlate infection, excessive tissue estrogens, and nutritional deficiency in the production of cervical carcinoma of the squamous type.

10. The possible concentration of estrogen around cervical cancer lesions arouses great hope for improved therapy with radioactive isotopes. Just as thyroid cancer may succumb to radioactive iodine, so also may the selective affinity of estrogen for proliferating Mullerian tissues enable successful treatment of cancer of the cervix.—*Mary Frances Vastine.*

PUND, EDGAR, R., and AUERBACH, STEWART H. Preinvasive carcinoma of the cervix uteri. *J.A.M.A.*, July 20, 1947, *134*, 960–963.

The recognition of carcinoma of the cervix in a truly early stage is one of the recent advances in the effort to control the disease. These lesions are being found because a search is being made for them. Ample and concise descriptions of the histopathology are available, and microscopic differentiation from non-cancerous squamous metaplasia has been emphasized. Various opinions as to the malignancy or non-malignancy of such lesions have been expressed by different writers, but the authors' observations have led them to believe that the cells of these disorders are fully neoplastic and will ultimately invade the tissues of the cervix unless eradicated. For this reason they consider the term "pre-invasive carcinoma" as best descriptive of the disease.

This paper represents the study of 1,200 cervices, most of which were from patients on whom total hysterectomies were performed. Representative samples of the entire cervix were obtained by cutting serial blocks from around the junctional area. Preinvasive carcinoma occurred in 47 instances, or in 3.9 per cent of the cervices examined. Hesitancy in the mind of either observer as to the nature of a lesion was sufficient to exclude equivocal cases. No invasive cancers were included, although several early and unsuspected ones were encountered.

The average age was 36.6 years. To determine the average age of noticeably invasive carcinoma of the cervix in women, 50 consecutive biopsies were selected at about the midperiod of this study. The average age was 48.6 years. About 28 per cent of those patients in the group of 1,200 on whom adequate data were available had complained of some form of intermenstrual bleeding. About 80 per cent of the women showed "normal" endocrine function as judged by single endometrial studies.

Wide variation in the gross appearance of the cervix was noted. The most obvious gross feature of the specimens was the absence of evidence of carcinoma. Its presence was not diagnosed from the gross appearance in any case. The neoplasms were located principally or entirely on the gland-bearing portion of the cervical lining, near or at the junction of stratified

squamous and columnar epitheliums. Involvement of the stratified squamous epithelial surface occurred to a notable extent in only 10 of the specimens and probably was attributable to downward growth and replacement rather than to origin on this surface. From the initial focus, possibly foci, the growing cells spread vertically and laterally over the endocervical surface, into the mouths and lumens of the endocervical mucous glands and, inconstantly, downward to displace stratified squamous epithelium of the vaginal aspect of the cervix. Evidence that the remote source of these cancers is the endocervical basal cell is fairly substantial. These groups of cells, which are demonstrable in nearly all human cervices, are capable of non-cancerous multiplication of squamous metaplasia. The location of these cells corresponds to the location of early carcinoma. Morphologically the primitive basal cell groups and the proliferating cell clusters bear a close resemblance to the common small cell surface neoplasms.

The authors believe that early detection by periodic examination offers promise. Screening for cancer by the vaginal smear technique of Papanicolaou and frequent use of biopsy are methods of special merit in view of the occult nature of the initial phases of the disease. If diagnosed in the preinvasive stage the chances of cure are excellent.—*S. G. Henderson.*

GENITOURINARY SYSTEM

Richards, C. E. Visco-Rayopake in cystourethrography. *J. Urol.*, Sept., 1947, *58*, 185–191.

Cystourethrography is useful in the diagnosis of bladder and urethral lesions such as neoplasms, calculi, foreign bodies, fistulae, extravasations, diverticula, strictures and congenital anomalies. This method of diagnosis is particularly valuable where cystoscopy is impossible and to provide a graphic record of disease for later comparison.

The history of cystourethrography and the development of various contrast media is traced by the author. Media which are satisfactory for cystography are usually not sufficiently opaque or viscous for urethrography. The disadvantages of the usual radiopaque media are discussed. These disadvantages include mucosal irritation, non-miscibility with urine and fat embolism.

A new medium, visco-rayopake, is discussed. Its chemical formula and composition is given. The pharmacology and toxicology has been tested adequately and the medium has been found innocuous in reasonable concentration. Visco-rayopake appears to be an ideal medium. Detail is better than provided by any media except the iodized oils and is at least equal to these. The medium is water soluble and freely miscible with urine. There is no risk of fat embolism. If the substance should be introduced into the venous system it is non-toxic.

The author has used visco-rayopake in 54 patients with excellent results. His technique includes adequate preparation of the patient by purgation and enemas and voluntary voiding of all urine possible. A preliminary film of the abdomen is exposed and a 2–4 per cent solution of sodium iodide introduced into the bladder through a urethral catheter. This solution is left in the bladder and the catheter removed. Twenty-five cubic centimeters of rayopake is then injected slowly into the urethra, the last 5 cc. during exposure of the film. An oblique film is then exposed at 45 degrees while another 5 cc. of medium is being injected. The amount and concentration of dye introduced into the bladder depends upon whether it is desired to outline the bladder or depict radiolucent encroachment on the bladder lumen. In the former case larger amounts of the more concentrated solution are used.—*Rolfe M. Harvey.*

Brodny, M. L., and Robins, S. A. The use of a new viscous water-miscible contrast medium Rayopake for cystourethrography. *J. Urol.*, Sept., 1947, *58*, 182–184.

The ideal medium for cystourethrography has not yet been perfected. Solutions of silver salts in adequate concentrations are injurious locally and toxic generally. Aqueous solutions of barium and bismuth leave insoluble particles in the bladder to act as niduses for calculus formation. Adequate concentrations of halogen salts are irritating. Oily preparations such as lipiodol and iodochlorol tend to form globules and interfere with visualization of the bladder base. Oil emboli are also to be feared with these preparations. It has been impossible to make the intravenous urographic media viscid enough for urethrography.

The authors introduce a new substance, rayopake, which has an iodine compound, 2,4-dioxo-3-iodo-6 methyl tetrahydropridine acetic acid, in a viscous base of polyvinyl alcohol. This has an excellent degree of radiopacity, may be diluted at will, being readily miscible with water

or urine, has good viscosity, has not led to embolism, shows no evidence of being a mucosal irritant, does not support bacterial growth and is completely removed by voiding. The authors secured satisfactory roentgenograms in 200 adults and 50 infants on whom the medium was used for cystourethrography.—*Rolfe M. Harvey.*

Silver, H. K. Wilms' tumor (embryoma of the kidney). *J. Pediat.*, Dec., 1947, *31*, 643–650.

This study is based on a series of 18 verified cases of Wilms' tumor. Thirteen cases had nephrectomy and 10 of the 13 are alive from two to fifteen years following therapy.

Wilms' tumor is the commonest abdominal neoplasm in children. Metastasis is by way of direct extension, the lymphatics or the blood stream, but is usually delayed. If complete histopathologic studies are made all characteristic cell types are usually present. The tumor is usually discovered before the age of six. Eleven patients were females and 7 males.

An abdominal mass was the commonest sign or symptom. Abdominal pain was present in half the cases. Urinary symptoms were infrequent. Gross hematuria was present in only 3 cases. The commonest physical finding was of an abdominal mass, solid, non-tender, and smooth in outline. The most difficult condition to differentiate was adrenal neuroblastoma. Other diagnoses to be considered are retroperitoneal sarcoma, polycystic kidney, hydronephrosis, lymphoma, splenic cyst and ovarian cyst.

Seven of 8 cases in whom blood pressure was recorded had hypertension. Pyelography disclosed distortion of the renal pelvis, displacement of the kidneys and ureters, and occasionally a non-visualized kidney pelvis. Aspiration biopsy is contraindicated.

The best type of treatment seems to be nephrectomy plus postoperative irradiation. The advisability of preoperative irradiation is disputed by many. Most authors employ preoperative irradiation only when the tumor is too large for operative removal.

Ladd and White in a summary of the literature in 1941 found 38 probable cures out of 563 reported cases. The authors report a survival rate of 76.9 per cent in 13 cases having nephrectomy. All patients having preoperative roentgen irradiation plus nephrectomy and postoperative roentgen irradiation are still alive (4 cases). The survival time varies from two and a half to fifteen years.—*Rolfe M. Harvey.*

Harvey, N. A. Kidney tumors; clinical and pathological study with special reference to the "hypernephroid" tumor. *J. Urol.*, April, 1947, *57*, 669–692.

The author first reviews the literature regarding hypernephromas. The present, most widely accepted conception of the origin of these tumors is that they arise from renal tissue rather than from adrenal rests. Fifty malignant kidney tumors and 8 incidental "hypernephroid" tumors encountered at the Rhode Island Hospital form the material on which this report is based. Renal tumors constitute 2 per cent of all tumors in adults and 20 per cent of all tumors in children.

In the author's series of kidney tumors 66 per cent originated in the cortex and 26 per cent in the pelvis; 81.5 per cent of the cases occurred in the fifth, sixth, and seventh decades. Seventy per cent of cases were in males. The tumors appeared to have a predilection for the upper pole and a few more cases were found on the left side than on the right. As in all previous reports the author found the symptoms to be protean and bizarre, with symptoms often being referable to metastases. The classical symptoms of pain, swelling and hematuria were present in only 17 per cent of cases. Hematuria was absent in 30–35 per cent of cases. Weight loss was the most common constitutional symptom. Gross hematuria occurred in 59 per cent of cases and microscopic hematuria in 77 per cent.

Roentgenology offers the best chance for early diagnosis. Survey films of the abdomen may reveal enlargement of the kidney, this being noted in 8 of 16 cases with such films in this series. Twenty excretory urograms were made in the present series. In 5 of these 20 the diagnosis could be made from the urogram alone. In 4 of the remaining 15 cases the urograms were of value because ureteropelvic block prevented retrograde study.

The retrograde pyelogram was the more reliable of the two procedures because of the finer detail provided. The commonest intrapelvic abnormality was a filling defect due to pressure on or invasion of the cortex. Elongation or constriction of the calices was frequently seen. The commonest extra pelvic urographic change, besides enlargement of the kidney, was renal and ureteral displacement.

In 20 of 34 cases a definite diagnosis of kidney tumor was made by urographic methods and in 15 per cent more it was suggested. The correct

diagnosis was made by retrograde pyelogram in 54 per cent and by intravenous pyelogram in 31 per cent. Lung and bone metastases were found by roentgen ray in only 7 per cent of cases.

The differential diagnosis must include enlarged spleen, enlarged liver, adrenal tumor, retroperitoneal sarcoma, ovarian cyst, polycystic kidneys and hydronephrosis.

In the autopsy group metastases were found in 100 per cent of cases, the lungs being involved in 45 per cent of cases; the bones, in 36 per cent; the liver, in 27 per cent; the lymph nodes, in 45 per cent, and the renal vein in 27 per cent.

The author advises against preoperative irradiation as allowing time for metastases to develop. The only exception is in the large fixed tumor in order to make operation more feasible. In inoperable cases roentgen therapy may relieve pain and prolong life.

The author includes the classification of renal tumors proposed by Ewing. He discusses the histopathology of his group of cases. He also discusses the theories as to the origin of the hypernephroid type of tumor, giving his reasons for discrediting the Grawitz theory of adrenal rest origin in favor of an intrinsic renal origin.—*Rolfe M. Harvey.*

GRAHAM, A. P. Malignancy of the kidney; survey of 195 cases. *J. Urol.*, July, 1947, *58*, 10–21.

In a period of fourteen years 195 cases of kidney malignancy were seen at the Hines Hospital. Hematuria was the presenting symptom in 31 per cent of cases, pain was present in 24 per cent, a mass was the initial symptom in 6 per cent, and gastrointestinal symptoms were the only complaint in 8 per cent. A mass could be palpated clinically in 41 per cent. Microscopic blood was found in 20 per cent and macroscopic blood in 13 per cent; 29 per cent had significant weight loss.

Seventy-two per cent of cases had retrograde pyelograms, 66 per cent of which were diagnostic. Compression of the calices was present in 59 per cent of those with positive retrograde findings, compression of the pelvis in 22 per cent, and elongation of a calix in 13 per cent. Twelve per cent had dilatation of the pelvis, 9 per cent had displacement of the ureter or pelvis, 2 per cent had tumor calcification and 10 per cent had ureteral obstruction.

Only 16 per cent of intravenous pyelograms were diagnostic as compared to 66 per cent of retrograde studies. Of 134 cases with histologic studies 86 per cent were cortical in origin; 37 per cent had metastases on admission. Of the cases with metastases 48 per cent were to the chest and 23 per cent to the bones. Forty-one per cent were considered inoperable on first admission. One-third of the cases which were operated were found to have metastases at operation.

Lung metastases were found in 69 per cent of 80 cases coming to autopsy, 39 per cent had liver metastases, and 36 per cent had bone metastases, the spine being most frequently involved.

Thirty-five per cent had nephrectomies. Seventeen per cent survived five years. Twenty-five per cent of the operative cases had preoperative irradiation varying from 500 to 6,000 r. One-third of these had demonstrable decrease in tumor size, all of these cases having over 4,000 r. The author questions the value of preoperative roentgen therapy in view of the fact that only one-third of the cases had reduction in tumor size, operation was delayed for six weeks, and poor healing of the incisions resulted in some cases. All cases receiving palliative therapy were dead within sixteen months.

Twenty-three per cent of the total series were misdiagnosed. The primary cause for delay in diagnosis appeared to be delay in investigation of original symptoms. Sixty-one cases having hematuria did not seek medical help for an average of twenty-three months.—*Rolfe M. Harvey.*

MCLAUGHLIN, W. L., and BOWLER, J. P. The suprarenal cortical syndrome; report of a case with carcinoma of the adrenal cortex. *J. Urol.*, Oct., 1947, *58*, 221–234.

The authors define the adrenal cortical syndrome as the sum of metabolic changes produced in the body by the presence of an excessive amount of adrenal cortical steroids. This can result from hyperplasia of the adrenal cortex through the adrenotropic hormone of the pituitary or from adenoma or carcinoma of the adrenal cortex.

Steroids are organic compounds with a molecular structure similar to cholesterol and possessing biological properties giving them hormonal characteristics. The testes and ovaries also produce hormonal steroids. These steroids influence fluid and electrolyte balance, affect protein sugar and fat metabolism, pigmentation, and masculinization and feminization of the body.

The biological properties of some of the steroids of the adrenal gland are discussed, desoxycorticosterone being the only one which has been synthesized. It is now being synthesized and used in the treatment of Addison's disease. Dehydroisoandrosterone is structurally related to testosterone and has androgenic properties. Clinically the adrenal cortical syndrome may be manifested by:

(1) Changes due to excess androgens or estrogens (adrenogenital syndrome)
   a. Female child toward adult masculinity.
   b. Female adult toward masculinity.
   c. Male child toward adult masculinity.
   d. Male adult toward femininity.

(2) Changes due to excess steroids of metabolism with or without excess of androgens and estrogens (Cushing's syndrome).

Aside from the clinical picture of rapid obesity of the face, neck and abdomen, thin, easily bruised skin, hirsutism, susceptibility to infection, muscle atrophy, loss of libido, amenorrhea and psychic changes, the patients develop spinal changes which are of interest to the roentgenologist. The spine becomes osteoporotic and collapse of the bodies is common. Steroids in the urine may be detected by laboratory methods.

Adrenal tumors may occasionally be diagnosed by roentgenography. Excretory urography may show caudad displacement of the kidneys. Perinephric air injections will often outline an adrenal tumor and in some hands appears to be an entirely safe procedure. The differential diagnosis between tumor and hyperplasia of the adrenals may be difficult.

The surgical management of adrenal tumors is discussed in detail.

The authors report the case history of a white male, aged forty-four, whose admission complaint was that of low back pain. The patient had had a hemorrhoidectomy fourteen months prior to admission. This had been followed by multiple pulmonary infarcts. Nine months before admission the patient's family noticed that he was developing progressive "bloating" of the face. For the past month and a half he had complained of low back pain. The blood pressure was 140/90. Atrophy of the muscles of the arm and leg was present. Blood chemistry was negative. The basal metabolic rate was low. Roentgenograms of the spine revealed marked osteoporosis with compression fractures of the second, third, and fourth lumbar vertebrae. An excretory urogram showed questionable depression of the right kidney. Symptoms progressed following discharge and a psychosis developed. On subsequent admissions the spinal osteoporosis had increased and at this time perirenal air insufflation showed a rounded mass above the right kidney. At operation a tumor was found in this area which was histopathologically a cancer of the adrenal gland. Following operation testosterone proprionate therapy was instituted with striking improvement in all symptoms. Thirteen months after removal of the tumor spinal roentgenograms showed complete recalcification of the spine.—*Rolfe M. Harvey.*

Berry, J. V., and Berry, N. E. Acute exudative cystitis of undetermined etiology. *J. Urol.*, Oct., 1947, *58*, 260–267.

This condition has been described under various names such as acute exudative cystitis, acute interstitial cystitis, acute hemorrhagic cystitis, amicrobic pyuria and Reiter's disease.

It is characterized by a nonspecific urethritis followed by an acute hemorrhagic cystitis. Clinically the onset is acute with frequency, profuse hematuria and absence of loin pain or fever. In Reiter's syndrome conjunctivitis and arthritis are also present. Dilatation of the upper urinary tract also occurs in the syndrome.

The authors have encountered 24 cases, mostly in soldiers. They report in detail 3 illustrative cases, including reproductions of intravenous urograms to show the characteristic contraction of the bladder and dilatation of the upper urinary tract. The cause of the condition is unknown, although a filterable virus has been suggested. The differential diagnosis must include gonorrheal and tuberculous urethritis and prostatitis. Smears and urine cultures should aid in the exclusion of these diseases.

The roentgen findings of a contracted bladder and dilated upper urinary tract are very suggestive of the syndrome. Response to neoarsphenamines is usually rapid.—*Rolfe M. Harvey.*

Van Duzen, R. E. Nephroptosis producing duodenal symptoms. *J. Urol.*, Nov., 1947, *58*, 304–308.

This is a series of 3 case reports in which symptoms were present referable to the upper gastrointestinal tract, and treatment for duodenal ulcer had been instituted for varying periods of time although the true pathological

causes of the symptoms were in the genitourinary tract. All 3 cases were operated upon and found to have fibrous bands extending from the renal hilum to the duodenum and exerting traction on the latter, especially in the erect position.

All 3 cases were relieved of their gastrointestinal symptoms by operative correction of the nephroptosis and in 2 cases by division of fibrous bands extending from the kidneys to the duodenum.—*Rolfe M. Harvey.*

Burkholder, T. M., and Braund, R. R. Massive calcinosis with chronic renal insufficiency due to polycystic kidneys. *J. Urol.*, June, 1947, *57*, 1001–1009.

The authors report the case of a forty-six year old white female whose admission complaints were of painful swellings of both shoulders, both subscapular areas, the left elbow and generalized body itching. The patient had been in good health until four years previously when she was siezed with an attack of substernal pain, nausea and vomiting and was told she had renal insufficiency due to polycystic disease. No abnormal calcium deposits were noted at that time.

Her health was good for three years after which she had recurrent bouts of hematuria, polyuria, intractable vomiting and weight loss. Four weeks before admission she noted rapid enlargement of the left shoulder with pain and itching. The right shoulder and left elbow were subsequently involved. Numerous subcutaneous masses, which appeared to be fluctuant cysts, could be palpated about the large joints. The urine contained albumin and numerous red blood cells. The blood urea nitrogen was 172 mg. per 100 cc. The serum phosphorus was 10.2 mg., the serum calcium 11.5 mg., and the alkaline phosphatase 5.4 Bodansky units.

Roentgen studies showed patchy calcification of the aorta, a large irregular dense calcification overlying the right lung and extending beyond the lateral chest wall and multiple irregular calcium deposits about the shoulder girdles, left elbow and both gluteal regions. The kidneys appeared enlarged to about three times their normal size although the pelves could not be visualized with diodrast.

A partial excision of the mass overlying the right chest wall was done. It was a multiloculated cystic mass containing tenacious chalklike fluid. No definite histologic diagnosis was made. The patient died in spite of therapy. An autopsy, limited to the abdomen, confirmed the presence of polycystic kidneys.

The differential diagnosis of the case in reference to calcinosis circumscripta, calcinosis universalis, myositis ossificans, metastatic calcifications, primary hyperparathyroidism and primary renal insufficiency is discussed. The authors' case is apparently one of chronic acidosis and hyperphosphatemia secondary to renal insufficiency as a result of polycystic kidney disease.—*Rolfe M. Harvey.*

Pearse, R., and MacMillan, R. L. Congenital arteriovenous aneurysm of the renal artery. *J. Urol.*, Oct., 1947, *58*, 235–238.

The authors describe the case of a sixty year old male who suddenly passed bright red blood during urination. This persisted for six days. Catheterization of the left ureter produced a few drops of very thick bloody fluid. The survey film of the abdomen was negative. A right retrograde pyelogram was also negative. A left retrograde pyelogram showed a rounded pressure defect on the middle and upper calices. The suggested diagnosis was that of polycystic kidney disease or early hypernephroma.

Four days after cystoscopy a left nephrectomy was performed and a saccular aneurysm of the renal artery, 4 cm. in diameter, was found. This communicated with a venous aneurysm which in turn caused a pressure effect on the left renal pelvis. The latter had been noted on the pyelogram.—*Rolfe M. Harvey.*